J.1
9/13/02

KERR-McGEE CHEMICAL LLC
800 WEYRAUCH STREET • WEST CHICAGO, ILLINOIS 60185

September 13, 2002
FLKE-007

PHONE
630-293-6330

VIA FEDERAL EXPRESS

Mr. Fred Micke
U.S. EPA, Region 5
On-Scene Coordinator
Emergency Response Section #3
77 W. Jackson Blvd. (SE-5J)
Chicago, Illinois 60604-3590

SUBJECT: Response to 8/16/02 U.S.EPA Comments to Investigation Report
Transmittal of Limited Removal Action Work Plan

REFERENCE: DuSable Park, Chicago, IL

Dear Mr. Micke:

Enclosed find Kerr-McGee's response to U.S. EPA's comments to the Investigation Report for DuSable Park in Chicago, IL.

Kerr-McGee has never owned or conducted operations on this Site nor was it a party to the filling operations in the 1980's that brought the Park up to its current topography. However, as a purely civic gesture, Kerr-McGee is proposing to perform a limited removal action at the Site. A work plan to perform this limited removal action has also been included with this transmittal.

Kerr-McGee currently has crews in the Streeterville area who would be available to perform this work. Their work for the 2002 construction season will be over by mid-October, at which time they will be laid off for the winter. If the U.S. EPA approves this Limited Removal Action Work Plan before that time, Kerr-McGee will perform the work outlined in the attached work plan.

Please call me at (630) 293-6331 if you have any questions.

Very truly yours,

KERR-McGEE CHEMICAL LLC

Mark Krippel
Program Manager

Attachments

cc: Mary L. Fulghum, Esq. (USEPA)
LeeAnn Tomas (Chicago Park District)
Burton Natarus (City of Chicago)

File: DPCH – EPA

K-M Distribution

B. Bono

T. Goresen

W. Green

H. Holmberg

D. Jedlicka

J.T. Smith

General Comments

1) *Both the U.S. Environmental Protection Agency (EPA) and Kerr-McGee data show concentrations in DuSable Park above the cleanup criterion of 7.1 picocuries per gram (pCi/g) total radium used in other parts of Streeterville. EPA upper bound measurements are up to 4 times the cleanup criterion. Kerr-McGee data is up to twice the cleanup criterion.*

The transmittal letter and overall reports should state that field work determined that there was material that exceeded the clean-up criteria. A volume estimate should be provided in the Report.

No basis for applying the Lindsay Light II "cleanup criterion" to this location has been established and if it were, the data support that this criterion was not exceeded. The UAO for the Lindsay Light II Site sets forth "cleanup criterion" as follows;

> "Conduct off-site surveying and sampling as necessary and, at a minimum, implement the standards of 40 Code of Federal Regulations ("CFR") 192, if deemed necessary should contamination be discovered beyond current site boundaries."

Individual measurements may exceed 7.1 pCi/g however, the "clean up criterion", as defined by the aforementioned Regulation, clearly contemplates 5 pCi/g total radium above background averaged over 100 square meters. From this perspective, all areas sampled satisfy the "clean up criterion". Nevertheless, limited material that encompasses the individual high readings will be removed as described in a separate Work Plan accompanying this response document. The volume of this limited material is estimated to be 2.5 cubic yards or less.

2) *Soil concentrations measured by Kerr-McGee are all lower than concentrations measured by the EPA's National Air and Radiation Environmental Laboratory (NAREL).*

Kerr-McGee does not dispute the analyses made at NAREL and suggests that both laboratories are right. However, as EPA understands, comments regarding disparate analytical results must be made in the context of similarity of the samples analyzed. If different sampling protocol is used in preparing samples for analysis different analytical results are not surprising. Kerr-McGee used the sampling protocol that was specified in the Investigation Work Plan approved by EPA. This approved Work Plan protocol produced samples representative of the soils at the sampling locations. The EPA sampling protocol screened out all soil particles of a size larger than 0.25 inches. This is not consistent with the approved Work Plan and produces samples that are not representative of the soils at the sampling locations.

3) *EPA and Kerr-McGee differ considerably on the total radium concentration for two of four areas. In one case EPA measured a concentration of 21.8 to 26.4 pCi/g while Kerr-McGee measured 9.5 pCi/g. In another, EPA measured a concentration of 5.5 to 7.0 pCi/g while Kerr-McGee measured 0.6 pCi/g.*

Again, these comparisons should not be made out of context. EPA's sampling protocol does not produce samples representative of the areas being investigated. They represent a subset containing the small particle size fraction of the soil matrix. Further, the instances where lab data and field data do not compare favorably suggest, as is typical in an urban fill environment, that the soil matrix is rather heterogeneous. Sampling techniques that focus on small subsets serve to amplify the variability between lab data and field data.

4) *It would have been beneficial, throughout the text, to have made a clearer distinction between soil concentrations based on gamma readings and soil concentrations based on laboratory measurements. The latter is an actual concentration measured in the laboratory, while the former is only a field estimate.*

In addition, the Report must have the "calibration curve" for each type of gamma reading estimation, i.e. gamma walkover and downhole logging.

For reasons already discussed, the gamma survey data is likely more representative of soil concentrations at DuSable Park than the EPA lab data. Kerr-McGee has many years of experience employing gamma survey techniques and has developed calibration standards that have been successfully used to quantify thorium-bearing materials in the field. EPA has even recognized the merit of these calibration standards and has utilized them with their instrumentation. Per your request, the calibration data for the field instrumentation have been provided.

Specific Comments

Transmittal letter from Wade A. Carlson to Bernard Bono dated June 12, 2002

1) ***Page 1, Para. 1*** *- The U.S. Environmental Protection Agency (EPA) did not supervise the work but observed the work as it was done.*

Acknowledged.

2) ***Page 1, Para. 4*** *– The text must clarified by saying that Kerr-McGee removed objects that did not pass through a 1 inch grid screen while EPA removed objects that did not pass through a ¼ inch grid screen.*

Acknowledged.

3) ***Page 2, Para. 6*** *– EPA used a slightly different method than did Kerr-McGee to compute the Total Radium concentration. Due to the fact that disturbing the soil releases radon-222, which reduces the lead-214 concentration (and, thus, the radium-226 concentration) when samples are not sealed and allowed to set for one month, it has been our procedure for the Lindsay Light sites to generally rely on the radium-226 concentration found at the 186 kilo-electron volts (keV) energy line as the upper bound concentration and the average lead-214 concentration as the lower bound concentration. This method gives a range that should encompass the concentration that would be obtained when samples are held for a month. Results form EPA's NAREL, and from Kerr-McGee are tabulated in the attached spreadsheets. Spreadsheet results are discussed after the review comments.*

In a subsequent comment, EPA states the gamma-spec report was dated May 29th. Given that the sampling occurred on May 7th, by May 29th the Pb-214 would be very close to equilibrium with Ra-226. Further, use of the 186 keV line as an upper limit is inappropriate since it is impacted by a 186 keV gamma line from the low concentrations of uranium in the sample. If the contribution from uranium is appropriately subtracted, upper bounds Ra-226 concentrations would be significantly lower.

4) ***Page 3, Laboratory*** *- The gamma reading for site 2756 indicates a soil concentration of 17.74 pCi/g. Table 3 in the Tables attachment indicates a laboratory measured total radium concentration of 0.6 pCi/g, with a radium-228 concentration of 0.44 pCi/g for site 2756. The gamma spectroscopy data in Attachment B for site 2756 indicates 0.14 pCi/g total radium with no data reported for any thorium radionuclides in the section "Identified Nuclides". The disparity and anomalous nature of this data is not discussed. EPA's data from NAREL indicates a total radium concentration range of 5.5 to 7.0 pCi/g for this site-see attached data sheets.*

The disparity between lab data and field data at this sample location is likely the result of the heterogeneity of the soil matrix. The step-out borings and surface gamma survey both indicate this anomalous location is very small in aerial extent.

5) ***Figures, Figure 2*** *-Area Bl and Area B2 are identified as the identical area. They are distinct areas. Each area should be identified separately.*

Acknowledged, although "distinct areas" may be a mischaracterization of their close proximity to each other.

6) ***Figure 6*** *- Around data point area 1951, the step-out hole 1826 must be labeled. Around data point area 832, the step-out hole 832N5 must be labeled.*

Acknowledged.

7) ***Attachment D*** – *This attachment appears to compute the average soil concentration over 100 m^2 around the 4 "hot spots." This computation is not discussed in the cover letter or any other text. This computation should not be viewed as justification that no cleanup is necessary because the average concentration is below a cleanup criterion of 7.1 pCi/g. Foremostly, this computation is based on estimated soil concentration using gamma count rates, not laboratory concentration data.*

Moreover, it has been EPA's protocol in Streeterville cleanup verifications for many years to first eliminate all hot spots in the 100 m^2 grid before taking soil samples. Since there are remaining hot spots in these grids they cannot be certified clean.

A Work Plan has been submitted under separate cover describing the removal of the identified "hot spots" so that EPA can certify that DuSable Park is clean.

Discussion of Attached Data Sheets

1) *The Data Summary Sheet, the first page of the attachment, shows a summary of both EPA's and Kerr-McGee's data, with total radium concentrations computed. The remaining data sheets show data, in more detail, by Thorium Decay Series, Uranium Decay Series, Actinium Decay Series and Miscellaneous Radionuclides.*

Acknowledged.

2) *It is not known what Gamma Fraction Limit and what Library Energy Tolerance Kerr-McGee used. These are critical parameters and should be contained in the Report.*

Gamma Fraction Limit and Library Energy Tolerance are just 2 of the many setup parameters that a gamma spectroscopist needs to consider when performing gamma-spec analysis. The summary level reports produced by the software and provided as attachments in the report do not provide this information. The gamma abundance level (gamma fraction limit) was set to 70% and the library energy tolerance was set to 2 keV.

Data Summary Sheet Explanations

1) *The column labeled ID references the ID number given to Attachment A of Kerr-McGee's report. These four ID's correspond to the IDs for the highest count rates in the four primary regions identified in the Attachment A data.*

Acknowledged.

2) *The column EPA Lower Bound is the concentration reported by NAREL for lead-214 in its data report dated May 29, 2002. It is a lower bound for radium-226 because the soil sample was not held long enough for equilibrium to be established and, therefore, it is less than the radium-226 concentration.*

The samples were collected on May 7th and reported by the lab on May 29th. The samples appear to have had sufficient time to re-establish a substantial fraction of equilibrium with Ra-226.

3) *The column labeled EPA Upper Bound is the concentration reported by NAREL as radium-226. It is an upper bound because it may also contain data attributable to uranium-235 since the energy lines for both are extremely close.*

A correction of the upper bound Ra-226 concentration to account for the contribution from uranium detected in 3 of the 4 EPA samples should have been performed. Each pCi/g of U-238 (Th-234) will contribute about 1 pCi/g equivalent of radium-226 activity using the 186 keV line. Therefore, the upper bound radium-226 limit calculated by EPA is biased high by 1 pCi/g for each pCi/g of Th-234 reported by NAREL.

4) *The columns labeled EPA (Ra-228) and Kerr-McGee (Ac-228) has both radium-228 results with both based on Ac-228 concentrations.*

Acknowledged.

5) *The Total Radium EPA Range column was determined by adding Pb-214 + Ra-228 data for the lower bound and by adding Ra-226 + Ra-228 for the upper bound. The Total Radium Kerr-McGee column was determined by adding Pb-214 + Ac-228.*

Acknowledged.

Data Summary Sheet Discussion

1) *Both EPA and Kerr-McGee data are dominated by thorium concentrations, versus uranium or actinium concentrations. This is reasonable for a thorium contamination source.*

The low radionuclide concentrations are, however, not consistent with the much higher concentrations that characterized the Lindsay Light II site, and could be indicative of remnants of historical gas mantle use/manufacturing or glass polishing operations unrelated to the LLII Site that have been conducted in the Streeterville area. Additionally, the anomalies might be naturally occurring thorium and radium associated with the brick and cinder urban fill pervasive at the site or coal and other natural

resources known to commonly contain elevated concentrations of radionuclides that have been stored at the site. To date, LLII cleanups have been associated with removing much higher concentrations of thorium bearing materials than have been identified at DuSable Park.

2) *Kerr-McGee reported no Ac-228 data for site ID 2756 although EPA had a Ra-228 concentration much over normal backgrounds. This is unexpected.*

The disparity between lab data and field data at this sample location is likely the result of the heterogeneity of the soil matrix. The step-out borings and surface gamma survey both indicate this anomalous location is very small in aerial extent.

3) *EPA total radium levels always exceed Kerr-McGee's. The reason may be due to the fact that Kerr-McGee left more large objects in their sample. EPA removed everything greater than ¼ inch while Kerr-McGee removed only that greater than one inch. More larger objects could dilute the concentration.*

KM used the sampling protocol specified in the Investigation Work Plan approved by EPA. The approved work plan protocol produced samples representative of the soils at the sampling locations. The EPA sampling protocol which screened out all soil particles of a size larger than 0.25 inches was inconsistent with the approved work plan and produced samples that are not representative of the soils at the sampling locations.

4) *EPA and Kerr-McGee have much different concentrations for site IDs 832 and 2756, (21.8-26.4 vs 9.5 pCi/g) and (5.5-7.0 vs 0.1 pCi/g), respectively. It must be noted that while all of the concentrations for ID 2756 are less than the cleanup level of 7.1 pCi/g, the range of the concentrations is unexpected.*

Kerr-McGee believes this data spread is expected given the difference in sampling practices.

5) ***Thorium Decay Series Discussion*** *– EPA counted its samples for 1000 minutes (16 hours, 40 minutes) while Kerr-McGee counted its samples for 30 minutes. The longer counts will give better accuracy for results.*

The longer count time should reduce the uncertainty of the measurement. EPA should explain why the longer more accurate duplicate counts for Sample 2756 produced uranium concentrations that differ by almost 250%.

6) *Kerr-McGee reported no thorium decay series data for site 2756 even though EPA data thorium data was several times over normal background concentrations. This is unexpected.*

Repeating #2 above, the disparity between lab data and field data at this sample location is likely the result of the heterogeneity of the soil matrix. The step-out borings and surface gamma survey both indicate this anomalous location is very small in aerial extent.

7) ***Uranium Decay Series Discussion*** – *Kerr-McGee did not report any data for Ra-226.*

Direct measurement of Ra-226 can only be achieved by using the 186 keV energy line. When uranium is present at similar concentrations, the results are unreliable for that energy line. Kerr-McGee recognizes this fact and does not attempt to directly measure Ra-226 in the presence of uranium.

8) ***Actinium Decay Series Discussion*** – *Neither EPA nor Kerr-McGee reported concentrations for Actinium Decay Series radionuclides.*

Acknowledged.

9) ***Miscellaneous Radionuclides Discussion*** – *Kerr-McGee did not report any K-40 concentrations for site IDs 832 and 2756 although EPA reported normal background concentrations. This is unexpected.*

The Investigation Work Plan for DuSable Park did not include the isotope K-40 in the list of nuclides to be analyzed. A longer count time could have aided in detecting this common naturally occurring radionuclide if it were beneficial to confirm that radioactive potassium is present in DuSable Park at concentrations greater than the numeric cleanup standard established for radium at the LLII Site.

10) *EPA reported a slight amount of Cs-137 for site ID 512. This could be attributable to background levels due to past atmospheric testing of atomic weapons.*

Acknowledged.

11) *Neither EPA nor Kerr-McGee reported any other miscellaneous radionuclides other than K-40 and Cs-137.*

Acknowledged.

DOWNHOLE GAMMA LOGGING

Ludlum Model 2221/44-62 Calibration

Model 2221 serial number: 138371

Probe 44-~~10~~62 serial number: 141662

Date: 4/15/02

Scaler Linear Check

Laser model/serial number: LUDLUM 5001 21043

Calibration Due Date: 12/13/02

Threshold set to 100 mv. M (tech. init.)

Laser setting in cts.	Multiplyer	As Found Scaler reading in cts.	After Adjustment Scaler reading in cts.
400	X1	400	400
400	X10	4030	4030
400	X100	40,300	40,300
400	X1000	403,230	403,230

Voltage Plateau

Source isotope/serial number: CS 137 / CST4

BKGD PLATEAU volts	BKGD PLATEAU counts	SOURCE PLATEAU volts	SOURCE PLATEAU counts
650	26	650	583
700	63	700	1591
750	222	750	3041
800	621	800	4114
850	647	850	4594
900	876	900	4806
950	1116	750	5056
1000	1096	1000	5299
1050	1076	1050	5217
1100	1051	1100	5196
1150	1073	1150	5279
1200	1055	1200	5307
1250	1108	1250	5203
1300	1110	1300	5244
1350	1127	1350	5169

Operating voltage selected: 1100

RBF 1.0-1-1

BF Reynolds 4/16/2002

Ludlum Model 2221/4 ~~10~~ 62 Calibration (continue

Model 2221 serial number: 138371

Probe 44-10 serial number: 147662

Date: 4/15/02 ☒ window verified at about 3830

Instrument BKGD

1 minute BKDG counts

394	404
399	409
425	419

Average: 408

Source Block Data

Source block ID: 2012-54-1TA, 2TA, 3TA, 4TA

1 minute Source Block counts

4211	4300
4232	4173
4208	4229

Average: 4226 cpm Net Average: 3818 cpm

Activity Calculation

Net Average source count rate of: 3818 cpm divided by 10 = 382

Times 7.2 = 2749 (A)

Square root of (A) = 52 times 2 = 104 (B)

3157 800

(A) plus the average BKGD = ~~2887~~ CPM/7.2 pCi

The cutoff value is: ~~2783~~ 3053 (CPM/7.2 pCi minus (B))

Calibration performed by: [signature] DATE: 4/15/02

Calibration approved by: [signature] DATE: 4/16/2002

DETECTOR CALCULATION

DETECTOR TYPE CM 2221 SER # 138371 PROBE # 147662

CALIBRATION DRUMS W/PVC PIPING: CABLE LENGTH 30' DIAMETER OF PIPE _____ SCH. OF PIPE ____ 40, ____ 80

DRUM NUMBER	pCi/g	1ST COUNT (cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
CD-1	1.7	1457	1412	1425	1431
CD-8	12.9	6158	6074	6387	6206
CD-7	23.4	9798	9780	9843	9807

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g
A= 917 R= 0.998 5.0 PCi/g = 2550 CPM
B= 386 7.2 PCi/g = 3700 CPM

CALIBRATION W/STEEL HOLLOW STEM AUGER PIPING: CABLE LENGTH 30' DIAMETER OF PIPE _____ SCH. OF PIPE ____ 40, ____ 80

DRUM NUMBER	pCi/g	1ST COUNT(cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
10	2.4	529	562	505	532
12	5.8	1461	1467	1416	1448
13	22.4	4364	4389	4437	4397

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g
A= 905 R= 0.997 5.0 PCi/g = 1144 CPM
B= 188 7.2 PCi/g = 1561 CPM

CALIBR. DRUMS W/PVC & GEOPROBE STEEL PIPING: CABLE LENGTH 30' DIAMETER OF PIPE _____ SCH. OF PIPE ____ 40, ____ 80

DRUM NUMBER	pCi/g	1ST COUNT(cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
CD-1	1.7	709	729	744	727
CD-8	12.9	3037	3075	3029	3047
CD-7	23.4	4927	5051	5087	5022

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g
A= 424 R= 0.999 5.0 PCi/g = 1413 CPM
B= 128 7.2 PCi/g = 1849 CPM

B J Lamoreaux 4/16/2002

WCP 379
File: REF 6.9-1-1

February 19, 1999

Source Checking on NaI-2221
138371
PROBE # 147662

1.	4211	2.	4300
3.	4232	4.	4173
5.	4208	6.	4229
7.	4274	8.	4165
9.	4189	10.	4302
Total	42283	Counts Range	
Average	4229	Average+10%	4651
		Average	4229
		Average-10%	3806

HP [signature]

Date 4/15/02

[signature] 4/16/2004

REF 6, 1-5

SURFACE GAMMA SURVEY

Ludlum Model 2221/4 10 Calibration

11/22/02

Model 2221 serial number: 117621

Probe 44-10 serial number: 121010

Date: 1/9/02

DUPLICATE

Scaler Linear Check

Pulser model/serial number: LM 500 1 21043

Calibration Due Date: 12/13/02

Threshold set to 100 mv. MJ (tech. init.)

Pulser setting in cts.	Multiplyer	As Found Scaler reading in cts.	After Adjustment Scaler reading in cts.
400	X1	400	400
400	X10	4005	4005
400	X100	40000	40000
400	X1000	400100	400100

Voltage Plateau

Source isotope/serial number: CS-137 1 CS-7A

BKGD PLATEAU		SOURCE PLATEAU	
volts	counts	volts	counts
650	1043	650	8486
700	1856	700	11333
750	1839	750	12871
800	2065	800	14625
850	2371	850	15487
900	2527	900	16387
950	2674	950	16970
1000	2730	1000	17225
1050	2701	1050	17418
1100	2733	1100	17735
1150	2767	1150	17671
1200	2784	1200	17604
1250	2936	1250	17936
1300	2785	1300	17654
1350	3249	1350	18331

Operating voltage selected: 1100

REF 4.9-1-1

BJ Thomas 11/9/2002

Ludlum Model 2221/44-10 Calibration (continued)

Model 2221 serial number: 117621

Probe 44-10 serial number: 121010

Date: 1/9/02 ☒ window verified at about 3830

Instrument BKGD

1 minute BKDG counts

1313	1268
1243	1234
1207	1280

Average: 1257.5

Source Block Data

Source block ID: 2012 - 54 - 1TA, 2TA, 3TA, 4TA

1 minute Source Block counts

8836	8710
8868	8847
8600	8677

Average: 8756 cpm Net Average: 7498 cpm

Activity Calculation

Net Average source count rate of: 7498 cpm divided by 10 = 749.8

Times 7.2 = 5399 (A)

Square root of (A) = 73 times 2 = 146 (B)

(A) plus the average BKGD = 6657 CPM/7.2 pCi

The cutoff value is: 6511 (CPM/7.2 pCi minus (B))

Calibration performed by: [signature] DATE: 1/9/02

Calibration approved by: BJ Schneider DATE: 1/15/2002

REF 6.9-14

Source Checking on NaI-2221 # 117621

PWIRE 12/10/0

1.	8836	2.	8677
3.	8868	4.	8826
5.	8600	6.	8697
7.	8710	8.	8462
9.	8847	10.	8662
Total	8718	**Counts Range**	
Average	8718.5	**Average+10%**	9591
		Average	8719
		Average-10%	7847
HP	[signature]	**Date**	1/9/02

[signature] 1/10/2002

REF 4.9-1-1

LIMITED REMOVAL ACTION WORK PLAN

DUSABLE PARK SITE

CHICAGO, ILLINOIS

KERR-MCGEE CHEMICAL LLC

September 13, 2002

TABLE OF CONTENTS

LIST OF FIGURES

WORK INSTRUCTIONS

STANDARD OPERATING PROCEDURES

SCOPE AND OBJECTIVES

This Limited Removal Action Work Plan provides an overview of the activities required to excavate five small areas of the DuSable Park Site that contain material slightly exceeding 7.1 pCi/g total radium (Ra-226 + Ra-228). These areas were investigated and confirmed to be extremely limited in areal extent during the May 2002 site investigation performed by Kerr-McGee Chemical LLC (Kerr-McGee) and ProSource Technologies. Based on the May investigation, total radium concentrations of 15 pCi/g or less will be encountered and less than two and one half (2-1/2) cubic yards of soil will need to be hand excavated. The limited removal action is expected to last only one or two days. The work will be performed at the DuSable Park Site (Site) located in Chicago, Illinois. The location of the Site is shown on Figure 1. The Site is currently a vacant parcel heavily overgrown with tall weeds and scrub trees.

The anomalies observed at the DuSable Park Site are consistent with naturally occurring thorium and radium concentrations commonly found in brick and cinder urban fill. Historically, contamination associated with the Lindsay Light sites has been associated with higher concentrations of thorium bearing materials.

Kerr-McGee has never owned or conducted operations on this Site nor was it a party to the filling operations in the 1980's that brought the Park up to its current topography. As a purely civic gesture, Kerr-McGee is proposing to perform a limited removal action at the Site.

Kerr-McGee will voluntarily perform this limited removal action utilizing its own personnel and qualified contractors. The work will be conducted by hand excavating the five small areas shown on Figure 2. The horizontal extent and depth of each small excavation area has been determined based on the May 2002 site investigation. These limits are shown on Figures 3 through 5.

This Limited Removal Action Work Plan describes the work to be performed, health and safety issues, and includes the Work Instructions and Standard Operating procedures (SOPs) to be used. The Work Instructions to be used include Surface Gamma Survey, Soil Sampling, Sample Preparation, Verification, Surveys for Unrestricted Release of Equipment and Decontamination. The Standard Operating procedures that will be used include Operation of the Canberra HPGe Gamma Detector (SOP 363), Moisture Analysis (SOP 365), Portable Survey Instrument Operability Checks (SOP 376), and Calibration of the Ludlum Scaler Ratemeter Model 2221 (SOP 379).

The five limited removal areas will be located in the field using a Trimble Pro-XR global positioning system (GPS) unit to navigate back to the previously identified areas. The limits of the five excavation areas as shown on Figure 2 will be excavated by hand and placed into plastic bags. The bags will then be placed inside an intermodal container or Supersack™ for transport to, and disposal at a US Nuclear Regulatory Commission (NRC) licensed facility. For this project, the material will be shipped to Envirocare of Utah using proper DOT shipping procedures. The choice of using supersacks or intermodal containers will be made by the Field Team Leader and will be dependent on the availability of containers and the time of the year that the removal action occurs.

When the five excavation areas have been excavated to the limits shown on Figure 2, the remaining excavation cavities will be surface gamma surveyed in accordance with the Surface Gamma Survey Work Instruction. Any remaining material exceeding 7.1 pCi/g total radium as measured by the surface gamma survey will also be removed from each excavation.

At the completion of the excavation, each excavation area will be surveyed and sampled in accordance with the Verification work instruction. Verification soil samples will be collected

using a shovel in accordance with the attached Soil Sampling Work Instruction. The soil samples will be collected from five spatially equidistant spots (five-on-a-die) within the excavation area. One-fifth of the soil sample will come from each grab sample location and then the grabs will be composited in a stainless steel mixing bowl. Samples will be homogenized in the field; and rocks, sticks and foreign objects greater than approximately one-inch will be removed.

The samples will be prepared in the lab in accordance with the Sample Preparation Work Instruction, moisture corrected in accordance with SOP 365, and analyzed for Ra-226 and Ra-228 using the Canberra HPGe Gamma Detector in accordance with SOP 363. Ra-226 is measured as Pb-214 and Ra-228 is measured as Ac-228.

The shallow excavations will not be backfilled. Side walls of the excavations will be knocked down to a 2H:1V slope so that they may be safely traversed.

REPORTING

A report of the verification results will be submitted to the U.S. EPA within 60 days after the excavation verifications are completed. The report will include a map of excavation areas and soil sample results.

ACCESS

The Kerr-McGee Field Team Leader will obtain access to the land parcels comprising the Site from the respective property owner (Chicago Park District) prior to beginning removal activities. This access will include permission for Kerr-McGee and U.S. EPA employees, contractors, agents, consultants, designees, and representatives to conduct actions required as part of this limited site removal action. The Environmental Access Agreement form has been included as Figure 6. Kerr-McGee will provide the U.S.EPA with a minimum of two-business days notice prior to the start of the limited removal action.

UTILITIES

Utilities will be located prior to performing any ground intrusive activity on the property. The Field Team Leader will be responsible for originating a request for a DIGGER Utility Locate for each property where excavation is proposed. The phone number for DIGGER is 1-312-744-7000. DIGGER clearances are valid for fourteen days.

DESCRIPTION OF CREW

Excavations will be performed using two or three laborers with shovels. The material will be excavated by hand and placed into plastic bags. The bags will then placed into a Supersack™ or loaded directly into an intermodal container.

In addition, a Health Physics (HP) technician will be present to perform the GPS survey, verification survey, soil sampling and decontamination tasks. A Kerr-McGee Field Team Leader will also be on site to oversee the work.

SITE LOCATION

N
W E
S

FIGURE 1
SITE LOCATION MAP
DUSABLE PARK, CHICAGO, ILLINOIS

ProSource
TECHNOLOGIES, Inc.

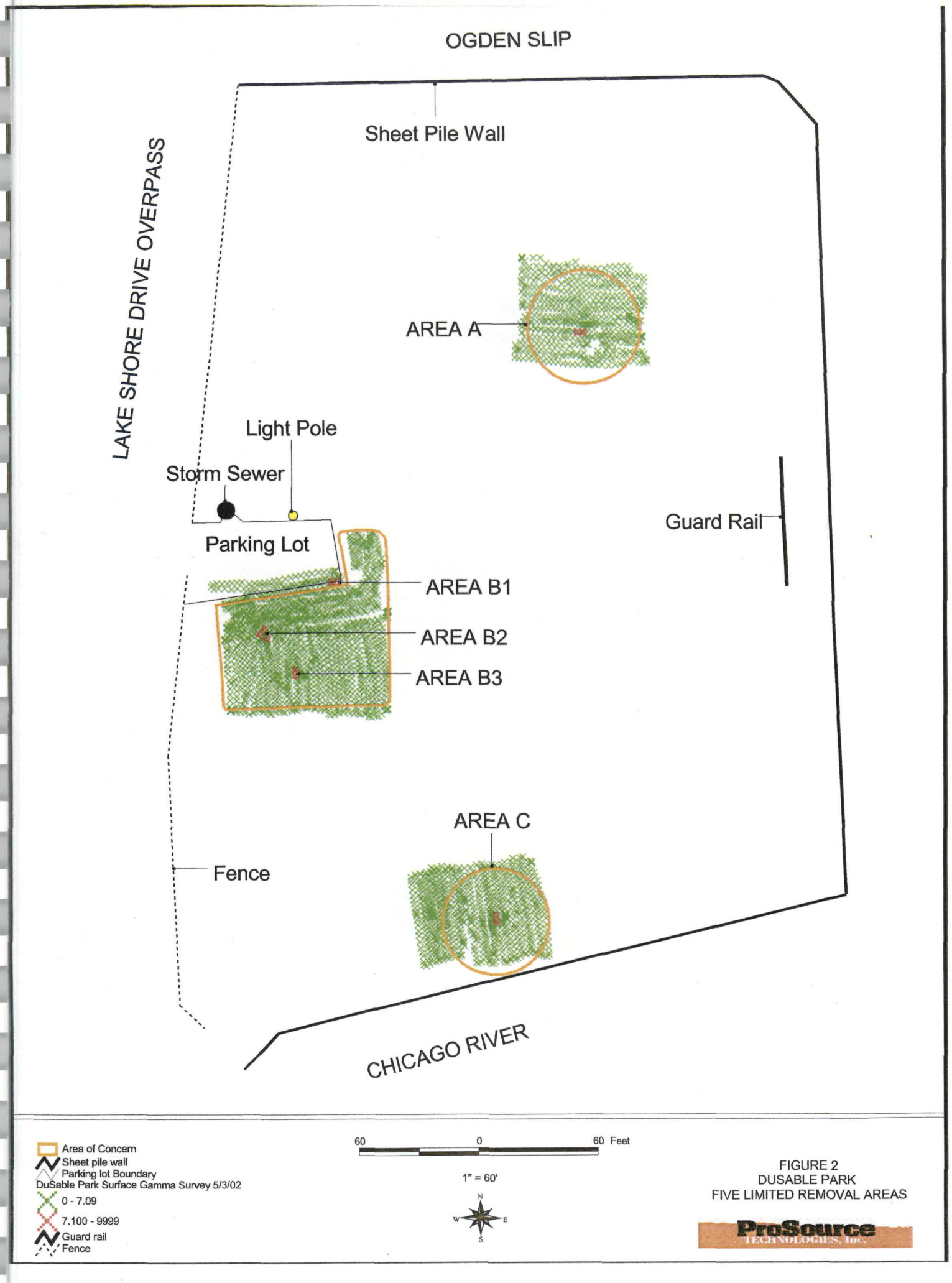
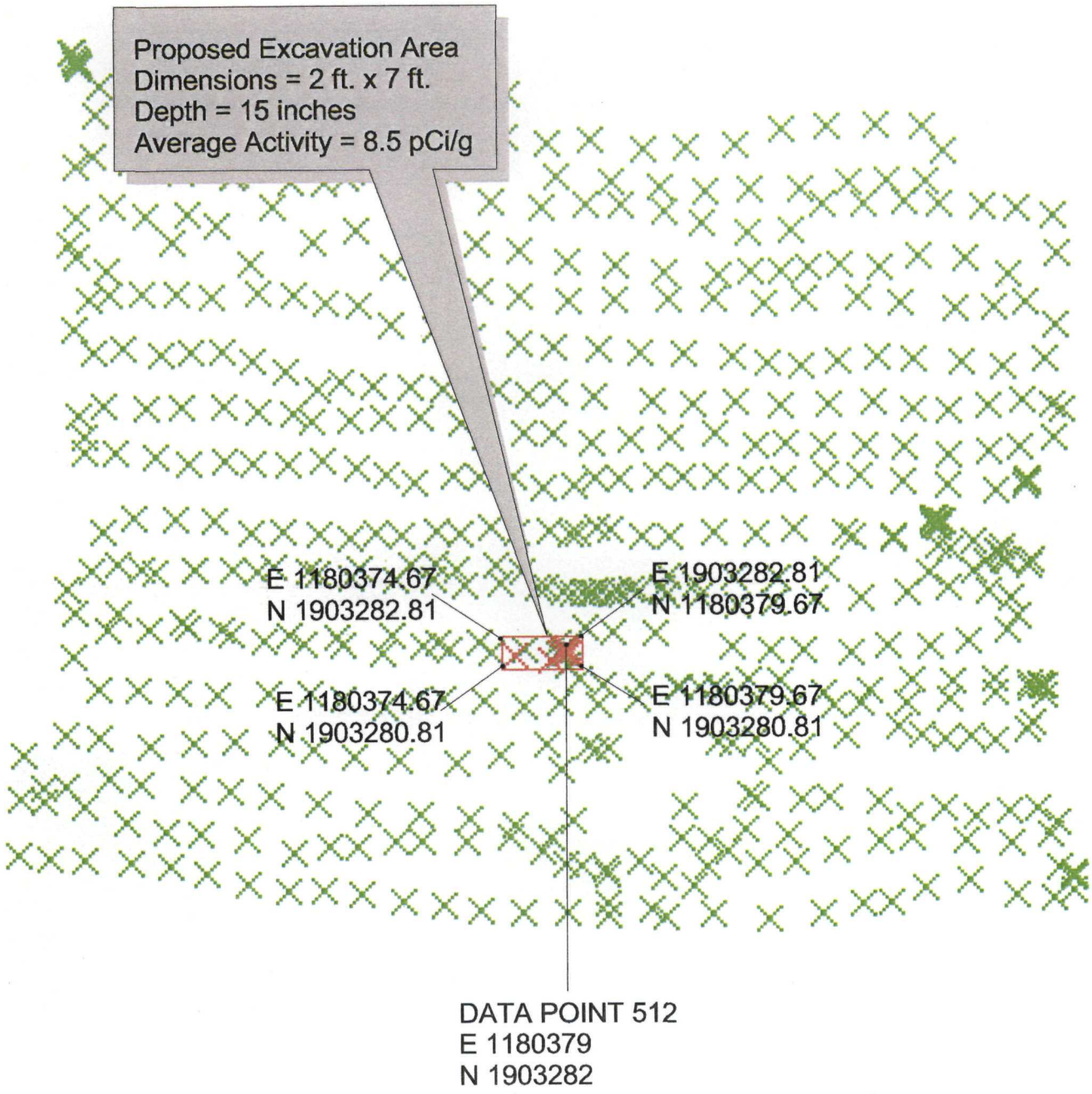


FIGURE 2
DUSABLE PARK
FIVE LIMITED REMOVAL AREAS

ProSource TECHNOLOGIES, Inc.



Note: Coordinates based on State Plane - Illinois East 1983

10 0 10 Feet

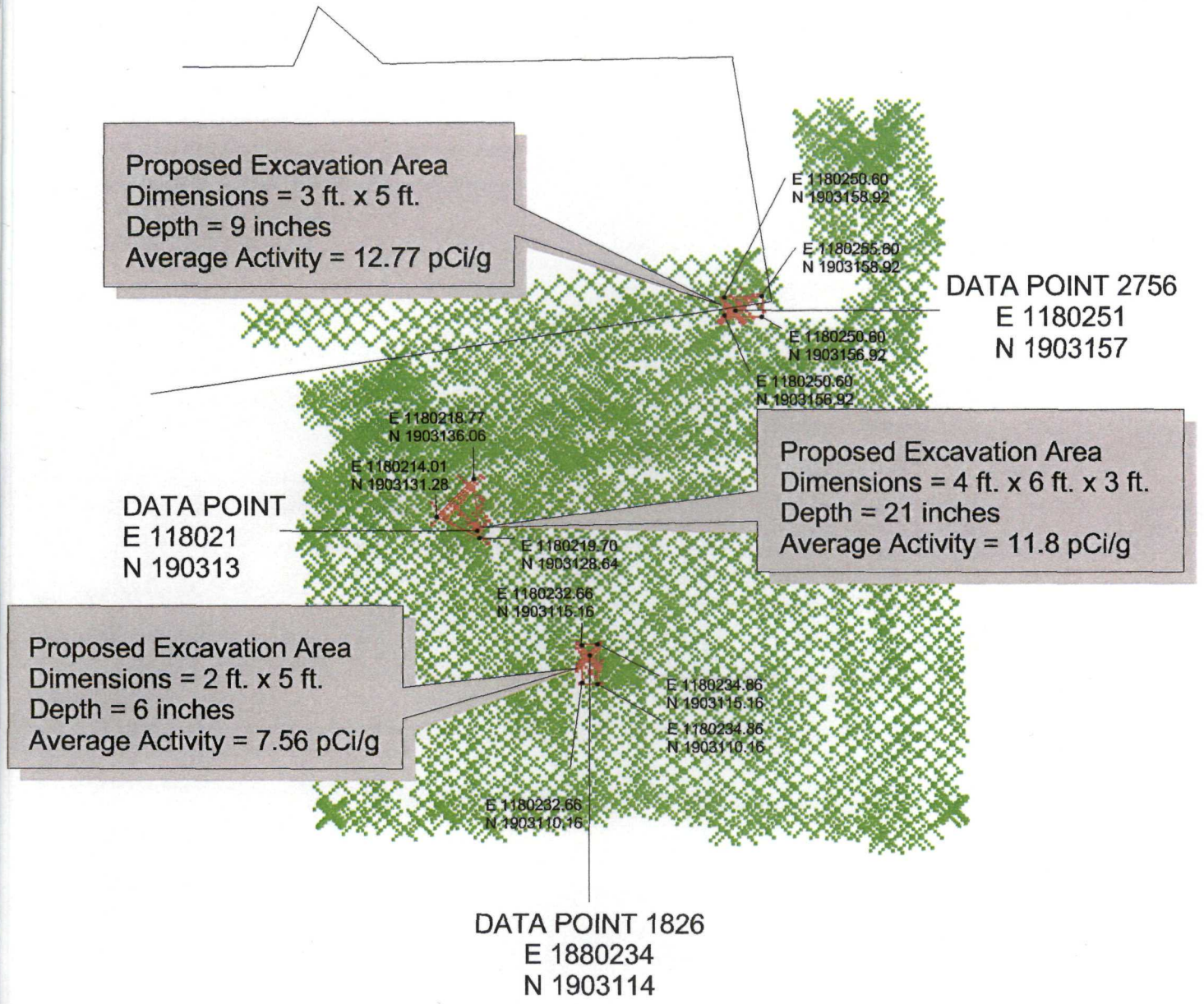
Parking lot Boundary
DuSable Park Surface Gamma Survey 5/3/02
0 - 7.09
7.100 - 9999

1" = 10'

N
W E
S

FIGURE 3
LIMITED REMOVAL - AREA A

ProSource TECHNOLOGIES, Inc.



Note: Coordinates based on State Plane - Illinois East 1983

20 0 20 Feet

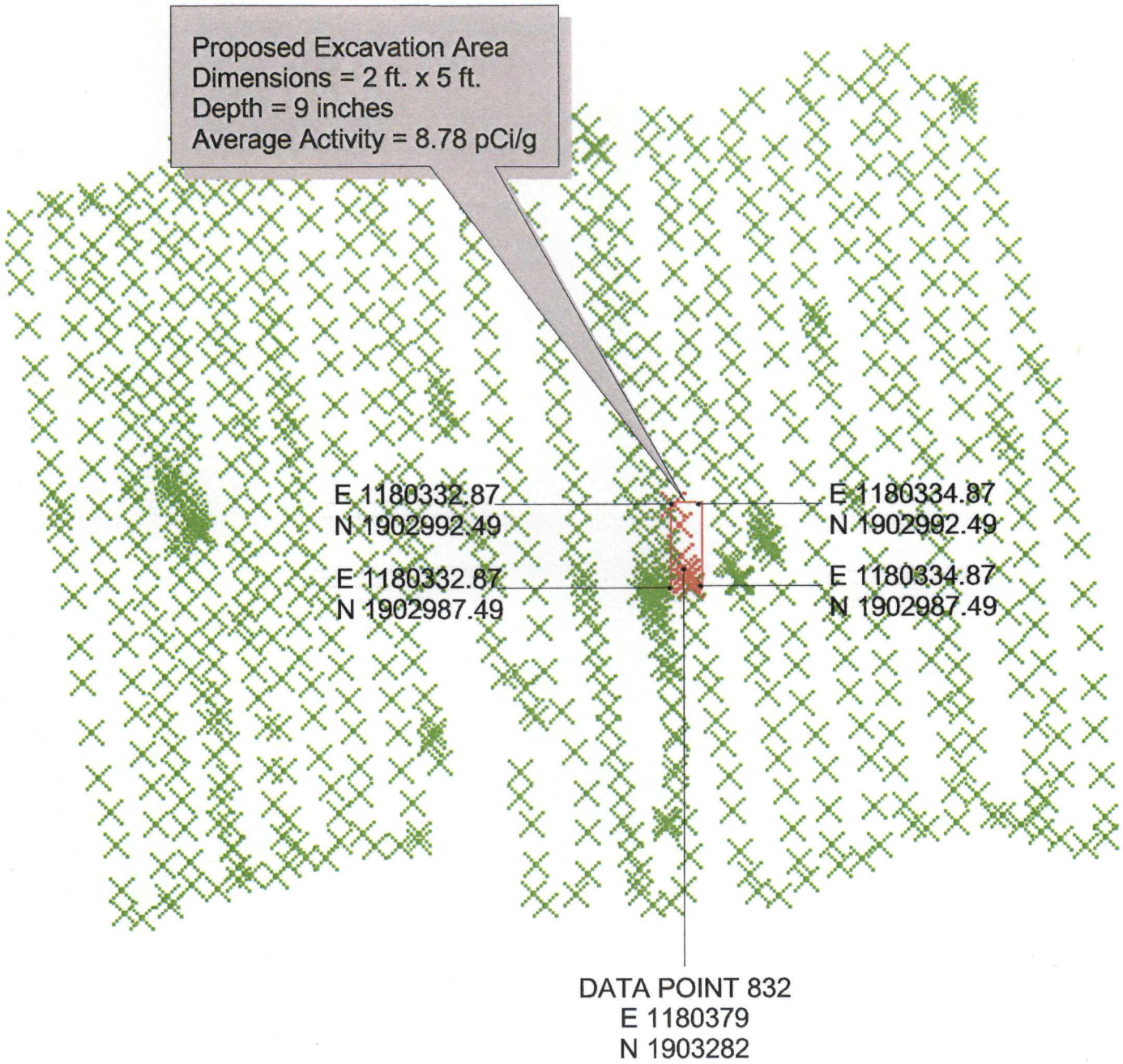
Parking lot Boundary
DuSable Park Surface Gamma Survey 5/3/02
0 - 7.09
7.100 - 9999

1" = 20'

N
W E
S

FIGURE 4
LIMITED REMOVAL
AREAS B1, B2, B3

ProSource
TECHNOLOGIES, Inc.



Note: Coordinates based on State Plane - Illinois East 1983

10 0 10 Feet

Parking lot Boundary
DuSable Park Surface Gamma Survey 5/3/02
0 - 7.09
7.100 - 9999

1" = 10'

N
W E
S

FIGURE 5
LIMITED REMOVAL - AREA C

ProSource TECHNOLOGIES, Inc.

HEALTH AND SAFETY

The Field Team Leader will ensure all work is done in a safe and proper manner. A brief tailgate meeting will be conducted on site before initiating work to explain potential hazards that may be encountered during the work. Potential hazards which could be encountered during remedial activities include contact with contaminated soil materials, contact with trespassers sleeping in the weeds, hazards associated with lifting and hand-excavation, contact with utilities, and contact with wild parsnip.

Constituents of concern that could be encountered during excavation activities include low-level radioactive material present in concentrations exceeding the action criteria. This may include U-238, Th-232 and progeny. Previous investigations have shown the soils to be excavated will contain total radium concentrations of 15 pCi/g or less.

The mechanisms for exposure for these materials are direct exposure, inhalation, ingestion, and eye/skin contact. The primary mechanism for exposure is direct exposure to external gamma radiation. All workers will be instructed in appropriate safety measures to protect against exposure to the above materials.

Trespassers shall be addressed in a courteous and professional manner, however if they become hostile or aggressive, the crew will vacate the work area and call the Chicago Police Department for assistance.

The site is heavily covered with wild parsnip, which can be a strong skin irritant on sunny days. The crew will be instructed to wear long sleeve shirts and gloves at all times they are working in the tall weeds area.

A restricted access area with an appropriate buffer will be created at the perimeter of the excavation areas. It is anticipated that the excavation work can be done in Level D PPE. Level D PPE for the project includes steel toed or OSHA approved safety work boots or shoes, safety glasses, rubber booties and disposable work gloves. All visitors entering the restricted access zone must have appropriate PPE and must be accompanied by the Field Team Leader. Level D PPE will not be worn outside of the restricted work zone, as this would unnecessarily alarm the community

All workers and visitors will follow decontamination procedures in accordance with Atomic Energy Commission levels in Regulatory Guide 1.86, Table 1 and, only if more restrictive, to State of Illinois regulatory levels if they come into contact with low-level radioactive material in concentrations exceeding the action criteria. Before leaving the exclusion zone, site personnel shall be checked through use of a hand-held frisker to ensure that contamination is not present on skin or clothes.

ENVIRONMENTAL ACCESS AGREEMENT

1. I (we), the undersigned, do hereby grant to Kerr-McGee Chemical LLC ("Kerr-McGee"), its employees, authorized representatives and contractors; United States Environmental Protection Agency ("U.S. EPA"), its representatives and contractors; license and permission to enter upon owners property described as:

   Property Address/Location: DuSable Park, Chicago, IL

   for the purpose of conducting limited removal action activities. Kerr-McGee is not U.S. EPA's representative with respect to liability associated with the Chicago Streeterville Area Projects, through December 31, 2002.

2. Upon conclusion of the limited removal action activities, Kerr-McGee shall remove all its equipment and removal action derived waste from the site. Excavations will not be backfilled, but sideslopes of excavations will be flattened to 2H:1V.

3. Kerr-McGee agrees to and does hereby expressly indemnify, save and hold harmless, and defend the Park District, its commissioners, officers, employees, volunteers, contractors and agents (collectively, the "Park District Indemnitees") against any losses, claims, damages, liabilities, actions, suits, proceedings, costs or expenses that the Park District Indemnitees may suffer, incur or sustain or for which it or they may become liable (including, but not limited to, personal and bodily injury to or death of persons or loss or damage to property) resulting from, arising out of, or relating to any negligent acts, errors or omissions of Kerr-McGee or its contractors in conducting limited removal action activities at DuSable Park.

Dated this _____ day of _____, 2002.

Chicago Park District:

_____

_____

Kerr-McGee Chemical LLC

_____

_____

DuSable Park

Surface Gamma Survey Work Instruction

Date: September 13, 2002

---

1. PURPOSE

This work instruction provides direction for surface gamma radiological survey work to be performed for the limited removal action at DuSable Park in Chicago, Illinois.

2. SCOPE

Radiological surveys will be performed at the Site as part of the verification of the excavation cavities created during the limited removal action.

3. REFERENCES

3.1 REF Facility Procedure - SOP-WCP 376 "Portable Survey Instrument Operability Checks"

3.2 REF Facility Procedure - SOP-WCP 379 "Calibration of the Ludlum Scaler Ratemeter Model 2221."

4. EQUIPMENT AND MATERIALS

The following equipment may be used as part of the survey programs. Other equipment may be substituted if necessary because of availability of the items listed or the conditions encountered at the site.

4.1 2-inch by 2-inch NaI (T1) gamma detector.

4.2 Ludlum Model 2221 portable scaler ratemeter analyzer.

5. INSTRUCTIONS FOR RADIOLOGICAL SURVEY

5.1 Ensure that excavation cavity is safe to enter.

5.2 The Ludlum ratemeter is set for 2-second time-weighted average count rate.

5.3 Hold the survey meter probe perpendicular to the ground surface at a height of approximately two to six inches.

5.4 Walk along back and forth over the excavation cavity area on one-meter grid lines at a maximum speed of about 0.5 meters per second (1 mile per hour).

5.5 Survey entire cavity, including sidewalls.

5.6 Prepare a map showing the results of the surface gamma survey on the remaining excavation cavity. Show the soil sample locations on the map.

6. RECORDS/REPORTS/NOTIFICATIONS

The following documents will be maintained as quality records:

- Map of surface gamma survey results.

DuSable Park

Soil Sampling Work Instruction

Date: September 13, 2002

---

1. PURPOSE

This work instruction provides direction for collecting verification soil samples to confirm that material exceeding 7.1 pCi/g total radium (Ra-226 + Ra-228) has been removed from the excavation, as part of the limited removal action at DuSable Park in Chicago, Illinois.

2. SCOPE

The DuSable Park samples will be collected from five spatially equidistant spots (five-on-a-die) within each excavation area. The Field Team Leader will coordinate the sampling efforts. Kerr-McGee's verification samples will be submitted to Kerr-McGee's laboratory for counting in a one-liter Marinelli geometry. The samples will be moisture corrected and analyzed for the U-238 and Th-232 decay series using the Canberra HPGe Gamma Detector.

3. REFERENCES

3.1 Surface Gamma Survey Work Instruction for DuSable Park

3.2 U.S. Nuclear Regulatory Commission, NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination, June 1992.

4. EQUIPMENT AND MATERIALS

4.1 Equipment and Materials Management

Sampling tools are cleaned in accordance with the Decontamination Work Instruction.

4.2 Sampling Equipment and Materials

Equipment used for soil sampling includes the following:

- Shovel and Trowel

- Plastic Collection Bags
- Plastic Sheets (optional)
- Sampling Tracking Form
- Container (for collecting potentially contaminated waste generated during the sampling process) (e.g., gloves, plastic sheets, etc.)
- Bucket or stainless steel mixing bowl (for homogenizing samples)
- Appropriate Personal Protective Equipment
- Paper Towels for decontamination
- Survey Instrument (for verifying clean sampling equipment and hands)

Other equipment may be substituted if necessary because of availability of the items listed or the conditions encountered at the site. Substitute equipment shall be approved by the Field Team Leader.

5. VERIFICATION SOIL SAMPLING

This section describes the methods for choosing sample locations and sampling methods.

5.1 Sample Location Selection

Layout an "X" diagonally across the excavation cavity. Mark the center of the X and the midpoint of each leg of the X (halfway between the center and each corner).

5.2 Sampling Procedures

In general, samples will be collected using a small shovel of trowel.

6. SAMPLE TRACKING

To establish the documentation necessary to track the sample from the time of collection, the sample identification and Sample Tracking Forms must accompany samples that are sent to the laboratory. If potential contamination is indicated (material history, etc.) the outside of the sample container will be screened for loose contamination.

7. SAMPLING METHODS

7.1 Verification Sampling

7.1.1 If necessary to minimize contamination, spread a clean sheet of plastic next to the area to be sampled; assemble the sampling equipment required.

7.1.2 Enter the complete information on the Sample Tracking Form:

- Sample Number
- Sample Matrix
- Sample Location
- Purpose of Sample Collection
- Include applicable comments regarding the sample, location, weather, conditions, or other factors that may be relevant
- Collected by (your name).

7.1.3 Mark the collection bag or prepare the identification tag for the sample.

7.1.4 Collect approximately one pound of dirt/urban fill from the surface of the excavation cavity at each of the five nodes marked (see section 5). Use a shovel or trowel to transfer the material to the mixing bowl.

7.1.5 Place the representative soil sample in mixing bowl and stir to ensure homogeneity and sample uniformity, if necessary. Remove rocks, sticks, and foreign objects greater than approximately one (1) inch. A one-inch sieve can be used if necessary. Transfer the homogenized soil/urban fill mixture to the collection bag.

7.1.6 Decontaminate the sampling equipment as required by Section 8.

7.1.7 The HP will record the sample locations on his excavation survey map.

7.2 Soil Sample Size

Each soil sample collected for radiological analyses will be a minimum of four (4) pounds and should not exceed 10 pounds. Sample size requirements are detailed in the Sample Preparation Work Instruction.

8. EQUIPMENT CLEANING

To avoid cross-contamination, the sampling equipment will be cleaned prior to and between sampling individual excavations. The following steps will be followed to clean equipment.

Remove loose contamination by gently tapping/shaking the item.

Using a stainless steel brush or paper towels, remove material that did not dislodge.

If the item appears to be clean (i.e., no visible clinging soil), proceed to the next sampling area.

If the item does not appear to be clean or if a survey with the appropriate instrument does not verify that it is, scrub the item with water. While holding the item over the sampling location, rinse the item with water.

Dry the item with paper towels or repeat the scrubbing sequence as necessary.

Dispose of cleaning materials, plastic sheeting, and associated items as contaminated materials in accordance with instructions provided by the Field Team Leader.

9. QUALITY CONTROL

9.1 QC Samples

To evaluate the variance in the soil sampling protocol, field duplicates will be collected at least once per sampling event and at a minimum of one duplicate per 20 samples. These QC samples will be identified and noted on the sample tracking log.

The duplicate will be taken from the homogenized sample collected from one of the five excavation areas. The duplicate will be randomly selected and identified before the sampling begins.

10. HEALTH AND SAFETY

Personal protective equipment and clothing, as required by the Health and Safety Section of the Limited Removal Action Work Plan, will be used when collecting and handling contaminated soils.

The site radiological conditions will be determined and documented before sampling begins.

11. RECORDS

The following documents will be maintained as quality records:

- Sampling Tracking Forms
- Results of all Calculations and Statistical Analyses Performed

SAMPLE TRACKING FORM

Date: Page ____ of ____

Sample Number	Matrix (S/W)	Location	Collected For	Comments	Collected By
All samples have been surveyed for removable contamination. None was detected.				Technician	Date/Time

Released by/Company	All samples are listed above are hereby released except for:	Date/Time
Received by/Company	All samples are listed above are hereby received except for:	Date/Time
Received by/Company	Data for all samples listed above are hereby received except for:	Date/Time

DuSable Park

Sample Preparation Work Instruction

Date: September 13, 2002

---

1. PURPOSE

This work instruction provides direction for sample preparation work to be performed as part of the limited removal action at DuSable Park in Chicago, Illinois. Kerr-McGee's verification samples will be submitted to Kerr-McGee's laboratory for counting in a one-liter Marinelli geometry. The samples will be moisture corrected and analyzed for the U-238 and Th-232 decay series using the Canberra HPGe Gamma Detector.

2. SCOPE

Kerr-McGee's laboratory will accept the soil samples collected in the field and prepare them following for gamma spectral analysis according to these instructions.

3. REFERENCES

3.1 State of Illinois Department of Nuclear Safety Radioactive Material License Number STA-583

3.2 Soil Sampling Work Instruction for DuSable Park

3.3 REF Facility Procedure - SOP-WCP 363 "Operation and Calibration of the Canberra HPGe Gamma Detector"

3.4 REF Facility Procedure - SOP-WCP 365 "Moisture Analysis"

3.5 REF Facility Procedure - SOP-WCP 380 "Use of Laboratory Standard Reference Methods Procedure"

4. EQUIPMENT AND MATERIALS

4.1 Tools, Material, Equipment

4.1.1 The following equipment is needed to perform this work:

a. 20 ml sample vials

b. A set of sieves ranging from one-inch to 100 mesh.

c. Bico-Braum Pulverizer

d. Riffle splitter

e. 2 qt plastic jars

f. aluminum pans

g. 4-inch Braum-Chipmunk Crusher

h. analytical balance

i. Marinelli beakers

j. zip-lock bags

k. labels

l. drying oven

4.2 Precautions, Limits

4.2.1 Personnel are to use extreme caution when using the "Chipmunk Crusher" and the "Pulverizer" because they can cause a serious injury.

4.2.2 All samples not known to be homogeneous must be homogenized prior to analysis.

4.3 Acceptance Criteria

Proper preparation ensures that the samples submitted to the laboratory are representative of the material sampled and suitable for the requested analysis.

5. SAMPLE PREPARATION METHODS

5.1 Marinelli Samples

The samples will be counted in a one-liter Marinelli geometry. The samples. The samples will be placed in a plastic collection bag and shall

weigh between four and ten pounds in accordance with the Soil Sampling Work Instruction for DuSable Park.

5.2 Sample Receiving

5.2.1 All samples are brought to the sample receiving area and the following information is documented in the "Sample Log".

a. Sample ID or address

b. Technician receiving samples

c. Date/time received

5.2.2 If the samples are not uniquely identified, assign a unique number to each sample and identify the number(s) on each sample and in the Sample Log.

5.2.3 Prepare the sample in accordance with the requirements of the analysis requested.

5.2.4 Sample(s) received for IDNS and/or USEPA are logged as received in the Sample Log Book. The appropriate agency is notified to pick up the sample(s) from the site laboratory. When samples are picked up, note the date and time in the Sample Log Book.

5.3 Sample Homogenization

Samples received by the lab will be placed into a clean container for blending. Soil clumps that would not fit into the Marinelli geometry will be broken. The soil will be blended using a steel trowel until an even consistency and color (as visually estimated by the lab personnel) is obtained.

5.4 Sample Container Preparation

5.4.1 The tare weight of the empty sample container shall be recorded.

5.4.2 The one-liter Marinelli sample container shall be filled in a manner that minimizes air voids in the soil matrix.

5.4.3 The sample shall be weighed using an analytical balance.

5.4.4 The sample weight shall be moisture corrected in accordance with SOP-WCP 365 "Moisture Analysis". The moisture corrected weight

and sample ID number are then written on the lid of the Marinelli sample container.

5.4.5 The lid is securely attached to the container and the sample is ready for gamma spectral analysis in accordance with SOP-WCP 363 "Operation and Calibration of the Canberra HPGe Gamma Detector".

6. RECORDS/REPORTS/NOTIFICATIONS

The following documents will be maintained as quality records:

- Samples shall be retained until all evaluations have been completed and the sample is no longer needed.
- Log Books shall be maintained by the Lab Supervisor until complete and then forwarded to Document Control for storage in the project files.

DuSable Park

Verification Work Instruction

Date: September 13, 2002

---

1. PURPOSE

The purpose of this procedure is to present protocol for notifying the U.S. EPA that a verification survey has been completed at a particular location, and that Kerr-McGee believes that all material exceeding 7.1 pCi/g total radium (Ra-226 + Ra-228) has been removed from the excavation.

2. SCOPE

After the individual excavation areas have been excavated to the design limits, they will be verified by gamma surveying and soil sampling. If verification results indicate that all material exceeding 7.1 pCi/g total radium has been removed, then the U.S. EPA will be notified by means of the attached form that the individual excavation area has been completed. Excavation areas are not proposed to be backfilled.

3. REFERENCES

3.1 Surface Gamma Survey Work Instruction for DuSable Park

3.2 Soil Sampling Work Instruction for DuSable Park

4. EQUIPMENT AND MATERIAL

None

5. INSTRUCTIONS

5.1 Notification

Kerr-McGee will notify the U.S. EPA when they believe all soils containing more than five picoCuries per gram (5 pCi/g) of total radium above background have been removed from an area. The notification shall be made in writing on the

attached notification form and shall be submitted to the U.S. EPA RPM/OSC by hand, by fax, or by U.S. mail. The sampling and analyses to support this belief shall be made available to the U.S. EPA at the site.

The U.S. EPA or its designee, shall perform their own surface gamma survey and verification sampling and analyses, in a timely manner and as they deem necessary, to verify that limited removal area has been completed to the extent defined in the Limited Removal Action Work Plan. U.S. EPA samples will be representative of material remaining in the excavation.

If U.S. EPA surface gamma survey, representative sampling and analysis results show additional excavation is necessary, this work, and the additional soil sampling and analyses, shall be done in a timely manner. This process will be continued until U.S. EPA verifies the limited removal areas have been completed to the extent defined in the Limited Removal Action Work Plan and notifies Kerr-McGee that the excavation is released.

EPA verification shall be in writing to Kerr-McGee and will be tendered by hand, by fax, or by U.S. mail. The U.S. EPA verification will include a description of the excavation in sufficient detail to allow the excavation to be identified, the date of the verification, and the signature of the U.S. EPA representative submitting the verification. U.S. EPA may use the bottom portion of the Successful Verification Survey form, or a different transmittal to document the verification, at their discretion.

5.2 Records Management

Verification survey data, including surface gamma scan results and laboratory analyses will be maintained as quality records

Notification of Successful Verification Survey

Excavation Identification: _____

Date of Verification Survey: _____

Time of Verification Survey _____ am/pm

The above-described excavation was surveyed at the time and date indicated above, and indicated that all soils exceeding 7.1 pCi/g total radium (Ra-226 + Ra-228) as measured by surface gamma scanning and representative soil sampling have been removed from the excavation.

Documents pertaining to this survey are available for inspection at the Kerr-McGee Chemical LLC West Chicago Construction Site Office.

Signed:

_____ Date

_____ (Print Name)

_____ (Print Title)

For Kerr-McGee Chemical Corporation

_____

The above-described excavation was surveyed on behalf of U.S. EPA, Region V on _____ at _____ am/pm. The results of this survey indicate that the material exceeding 7.1 pCi/g total radium as measured by surface gamma scanning and representative soil sampling, has been removed from the excavation.

Authorization is hereby granted to Kerr-McGee to remove the exclusion zone designations around this excavation.

Signed:

_____ Date _____

_____ (Print Name)

_____ (Print Title)

For U.S. EPA Region V

DuSable Park

Surveys for Unrestricted Release of Equipment

Work Instruction

Date: September 13, 2002

1.0 PURPOSE

This work instruction establishes the criteria for releasing equipment or materials out of the Exclusion Zone. These methods are to be used to minimize the spread of radioactive contamination.

2.0 SCOPE

Kerr-McGee's Health Physics personnel shall perform a release survey on equipment or material that has come into contact with material exceeding 7.1 pCi/g (as determined by Surface Gamma Survey) before it leaves the immediate area, and prior to beginning limited removal activities in another area on the Site.

3.0 REFERENCES

3.1 U.S. Atomic Energy Commission Regulatory Guide 1.86 (AECREG 1.86), Dated June 1974.

3.2 Surface Gamma Survey Work Instruction for DuSable Park

3.3 Verification Work Instruction for DuSable Park

3.4 Decontamination Work Instruction for DuSable Park

4.0 DEFINITIONS

4.1 Beta-Gamma to Alpha Decay Ratio

A thorium-232 decay series produces about 0.5 beta-gamma decays for every one alpha decay. This ratio allows the limits for alpha contamination to be verified using beta-gamma survey instruments.

4.2 Clean Area

This term defines radiation conditions within a specified area. An area where the radiation levels and contamination levels are maintained below 2 mrem/hr and 20 dpm/100 cm^2 removable alpha respectively.

4.3 Contamination Surveys

An assessment that may include, as appropriate, surveys for loose and fixed contamination through the use of direct frisks and large area wipes to locate and quantify the radioactive material present.

4.4 Exclusion Zone

If surface gamma survey results indicate that contamination exceeding 7.1 pCi/g is present at the surface, then a restricted access area will be created at the perimeter of known contamination, with an appropriate buffer.

4.5 Large Area Wipes

Paper towels or masslin used to wipe large areas to identify the presence of loose contamination.

4.6 Unrestricted Release

Release of equipment or materials from the Exclusion Zone to any destination other than a licensed facility.

5.0 REQUIREMENTS

5.1 Prerequisites

5.1.1 Health Physics personnel shall ensure that all portable survey equipment used for this procedure are properly functioning and have a valid calibration sticker.

5.1.2 The Health Physics Supervisor or designee shall ensure that all personnel who are required to perform this procedure are properly trained and understand this procedure.

5.1.3 Equipment, vehicles and areas should be free of visible dirt, mud or dust prior to performing a contamination survey.

5.2 Tools, Material, Equipment

5.2.1 *The following counting equipment, or their equivalents, should be* used for performing contamination surveys on equipment and materials:

- (Beta-Gamma) Eberline PRM6 rate meter coupled to an HP-210 shielded GM detector.
- (Beta-Gamma) Ludlum Model 3 rate meter coupled to a Model 44-40 shielded GM detector.
- (Alpha) Ludlum Model 12 rate meter coupled to a 43-20 gas proportional detector.

5.3 Precautions, Limits

Direct and removable surveys should not be performed on wet surfaces, for alpha contamination. Wet surfaces should be surveyed only for beta-gamma contamination.

5.4 Acceptance Criteria

Prior to unrestricted release from the Exclusion Zone, all vehicles, equipment and materials shall be surveyed for contamination. If contamination exceeding AECREG 1.86 Table 1 limits is found, then the vehicle, equipment, or material should be decontaminated in accordance with the DuSable Park Work Instruction for Decontamination

6.0 PROCEDURE

6.1 Materials, equipment and vehicles that have come into contact with material exceeding 7.1 pCi/g shall be surveyed for contamination by using large area wipes and by direct frisk as appropriate.

6.2 Large area wipes will be frisked for alpha and/or beta/gamma contamination. Results will be compared against removable contamination limits included in AECREG 1.86 Table 1.

7.0 ATTACHMENTS

Attachment 1 AECREG 1.86 (Published June 1974)

DuSable Park

Decontamination Work Instruction

Date: September 13, 2002

1.0 PURPOSE

The purpose of this work instruction is to provide instructions for the decontamination of personnel and equipment.

2.0 SCOPE

Kerr-McGee's Health Physics personnel shall oversee decontamination of personnel, equipment or materials that have come into contact with material exceeding 7.1 pCi/g (as determined by Surface Gamma Survey, Verification or Unrestricted Release Surveys).

3.0 REFERENCES

3.1 U.S. Atomic Energy Commission Regulatory Guide 1.86 (AECREG 1.86), Dated June 1974.

3.2 Surface Gamma Survey Work Instruction for DuSable Park

3.3 Verification Work Instruction for DuSable Park

3.4 Surveys for Unrestricted Release of Equipment Work Instruction for DuSable Park

4.0 DEFINITIONS

4.1 Clean Area

This term defines radiation conditions within a specified area. An area where the radiation levels and contamination levels are maintained below 2 mrem/hr and 20 dpm/100 cm^2 alpha respectively.

4.2 Contamination Control Area

This term defines radiation conditions within a specified area. An area that may be contaminated to a level greater than a Clean Area.

4.3 Exclusion Zone

If surface gamma survey results indicate that contamination exceeding 7.1 pCi/g is present at the surface, then a restricted access area will be created at the perimeter of known contamination, with an appropriate buffer.

4.4 Frisking

A personal survey of an individual's clothing and exposed body performed to determine if contamination is present.

4.5 Protective Clothing

Reusable or disposable coveralls, boots and gloves that provide a barrier between contamination and personnel.

4.6 Thermoluminescent Dosimeter (TLD)

A device that measures radiation dose.

5.0 REQUIREMENTS

5.1 Prerequisites

5.1.1 Health Physics personnel shall ensure that all portable survey equipment used for this procedure are properly functioning and have a valid calibration sticker.

5.1.2 The Health Physics Supervisor or designee shall ensure that all personnel who are required to perform this procedure are properly trained and understand this procedure.

5.2 Tools, Material, Equipment

5.2.1 Decontamination facility.

5.2.2 Plastic Sheeting, brushes, scrapers, soap, water, scrub brushes and other material as necessary to decontaminate personnel and equipment.

5.3 Precautions, Limits

Decontamination of personnel with material other than soap and water will only be done when authorized by the Site Manager, Health Physics Supervisor, or a medical doctor.

5.4 Acceptance Criteria

5.4.1 Personnel shall be free of contamination after decontamination.

5.4.2 Material and equipment being decontaminated, for unrestricted release, shall meet the release limits established in Reference 3.4.

6.0 PROCEDURE

6.1 Personnel Decontamination

6.1.1 Personnel who are contaminated to greater than 100 corrected counts per minute (ccpm) shall notify the health physics technician.

6.1.2 The HPT shall resurvey the individual to determine the exact location of the contamination and document it on the Contaminated Personnel or Personal Effects Report (Attachment 1).

6.1.3 If the contamination is spotty, the HPT shall attempt to decontaminate the individual using swabs or soap and water. If the decontamination is successful, document the results on Attachment 1.

6.1.3.1 If contamination is determined to be in an individual's eyes, the eyes may be flushed, using an eye wash station.

6.1.3.2 If contamination remains in the eyes after flushing or is determined to be in an individual's nose or ears, decontamination will be performed under the direction of qualified medical personnel.

6.1.3.3 Cleansing methods for skin decontamination, in order of harshness are as follows:

- Lifting off with sticky tape.
- Flushing with water.
- Soap and cool water.
- Mild abrasive soap, soft brush, and water.

- Detergent (soap powder).
- Mixture 50% powdered detergent and 50% cornmeal.

6.1.4 If the contamination cannot be easily removed or the contamination is wide spread, the HPT shall escort the individual to Kerr-McGee's West Chicago decontamination facility and notify the Health Physics Supervisor.

6.1.5 The contamination shall be removed by having the individual wash with soap and warm water several times if necessary. The methods listed above may be used by the HPT.

6.1.6 If the decontamination is successful, document the results on Attachment 1.

6.1.7 If, after several attempts, the contamination is not successfully removed, notify the Health Physics Supervisor.

6.2 Tool Decontamination

6.2.1 All tools being removed from the Exclusion Zone shall be checked by the HPT.

6.2.2 Tools that are contaminated shall be decontaminated before they can be released from the Exclusion Zone.

6.2.3 Tools shall be decontaminated by the users under the direction of the HPT.

6.2.4 Tools can be decontaminated using scrub brushes and soap and water, wiping with damp rags or wipes, soaking in a decontamination solution, or other safe method approved by the HPT.

6.2.5 All interior surfaces of the tools must be decontaminated as well prior to the tool being unconditionally released.

6.2.6 If the tool cannot be decontaminated after several tries, then the tool shall be placed in a plastic bag and transported to Kerr-McGee's West Chicago decontamination facility and the Health Physics Supervisor shall be notified.

6.3 Equipment Decontamination

6.3.1 If equipment used in the limited investigation becomes contaminated with material exceeding 7.1 pCi/g, the contamination shall be removed prior to performing the survey for unrestricted release.

6.3.2 The equipment shall be placed on a sheet of plastic, so that any removed contamination will be collected.

6.3.3 Contamination shall be removed by light brushing or scraping. If dry methods are not successful, then wet washing with a scrub brush and soapy water would be performed. Spray washing shall only be used as a last alternative.

6.3.4 Once the equipment is washed, it will be surveyed by the HPT. The HPT will identify any areas on the equipment that need further decontamination and will make recommendations on how to further decontaminate.

6.3.5 All surfaces of the equipment must be decontaminated and surveyed. This includes air intakes, air filters and any internal surface that is likely to be contaminated.

6.3.6 Once the equipment has been surveyed by the HPT and determined to comply with the release limits included in the Unrestricted Release of Equipment Work Instruction, then the item can be released.

7.0 RECORDS/REPORTS/NOTIFICATIONS

7.1 Release surveys and personnel decontaminations shall be documented on the appropriate form. These records will be forwarded to the project files for retention by the Health Physics Supervisor.

7.2 Personal contaminations shall be reported to the Health Physics Supervisor and the Site Manager.

8.0 ATTACHMENTS

8.1 Attachment 1Contaminated Personnel or Personal Effects Report

Attachment 1 (*Example*)
CONTAMINATED PERSONNEL OR PERSONAL EFFECTS REPORT

DATE OF INCIDENT	TIME OF INCIDENT
NAME	BADGE NO
LOCATION OF INCIDENT (SPECIFIC AREA)	

DESCRIPTION	DESCRIBE IN DETAIL ANATOMICAL LOCATION, CONTAMINANT, TYPE OF INJURY, OR CONTAMINATED ARTICLE:

CONTAMINATED ARTICLE OR AREA	DECONTAMINATION AGENT USED	INSTRUMENT	SURVEY RESULTS BEFORE	SURVEY RESULTS AFTER	FINAL DISPOSITION OF ARTICLES

WOUND COUNT /5 MIN	BKGD COUNT /5 MIN	SOURCE COUNT /5 MIN

SAFETY MEASURES	PERTINENT SAFETY MEASURES IN EFFECT ☐ YES ☐ NO	IF NO, EXPLAIN

REMARKS	

EMPLOYEE SIGNATURE	HEALTH PHYSICS SIGNATURE

showing material above & below 7.2. Granted exceptions different color.

OPERATION AND CALIBRATION OF THE CANBERRA HPGe GAMMA DETECTOR

1.0 SCOPE

1.1 Purpose

The Canberra HPGe detector system is used for the non-destructive x-ray and gamma ray spectral analysis of environmental and site operations media. This procedure describes the general operational steps for routine analysis and calibration. Calibrations are performed in reproducible, standardized geometries to ensure accuracy and precision of analytical results.

1.2 Applicability

This procedure applies to the quantitative and qualitative x-ray and gamma ray analysis of environmental and site operations media. Quantitative analyses are performed only on standardized geometries. Qualitative analyses are performed for identification purposes only, including any non-standard media.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 State of Illinois Department of Nuclear Safety Radioactive Material License Number STA-583

2.5 Canberra PROCOUNT Operations Manual

2.6 Canberra Germanium Detectors User's Manual

2.7 Canberra Operating Manuals (the equations for calculating sample activity)

2.8 Amersham Certificate of Calibration (DV648)

3.0 DEFINITIONS

None.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 The system records live time, clock time and dead time and stores this information with the sample spectra. Live time is used for all sample activity calculations.

4.2 Tools, Material, Equipment

4.2.1 Digital Equipment Company (DEC) MicroVax 3000 workstation or equivalent.

4.2.2 Canberra high-purity germanium (HPGe) detector or equivalent. The HPGe detector(s) is a reverse electrode type, with very thin ion implanted electrode. The cryostat is topped with a very thin aluminum endcap. This combination maximizes sensitivity for low energy photopeaks by offering improved resolution along with flatter efficiency response. The detector(s) is approximately 50 mm diameter by 50mm thick and around 25% efficient (relative to a 3" X 3" Nal(T1)).

4.2.3 Canberra spectroscopy amplifier Model 9645 or equivalent.

4.2.4 Canberra high voltage power supply Model 9645 or equivalent.

4.2.5 Canberra analog-to-digital converter (ADC) Model 9633 or equivalent.

4.2.6 Canberra acquisition interface module (AIM) Model 556 or equivalent.

4.2.7 Canberra nuclear instrumentation BIN Model 2100 or equivalent.

4.2.8 Nuclear Data remote parallel interface (RPI) or equivalent.

4.3 Precautions, Limits

4.3.1 Background checks will be performed on a daily or prior to use basis.

4.3.2 Instrument response or efficiency checks will be performed on a daily or prior to use basis.

4.3.3 NIST traceable standards should only be used for calibrations.

4.3.4 Amersham Mixed Gamma Standards do not require coincidence/summing corrections. NIST SRM 4276C Mixed-Radionuclide Solution Standard requires corrections for coincidence/summing.

4.4 Acceptance Criteria

4.4.1 Samples shall be analyzed for a sufficient time to achieve the required sensitivities. Typically counting times of 15 to 1000 minutes are used.

The Project required sensitivities vary for soil, water and air particulate samples. Attachment *1* provides the sensitivity for 1500 grams of soil in a one-liter Marinelli beaker geometry, using a 1000 second counting time. Soil sensitivities of ≤ 1 pCi/g for Ra-226 and Ra-228, and ≤ 5 pCi/g for U-238, using appropriate progeny, are adequate for both the off-Site (Superfund) and on-Site (Rare Earth Facility) projects.

5.0 PROCEDURE

5.1 Initial Detector Electronics Setup

5.1.1 Menu items can typically be selected by typing the option number and selecting the return function key. Alternately, the menu item can be highlighted by using the up and down arrow keys and selecting the PF1 function key.

5.1.2 Verify or establish the high voltage power supply settings.

NOTE: Polarity is critical and should be noted and recorded in the maintenance log. If polarity is changed the detector will be damaged.

5.1.2.1 Click on the MCA option box located in the left margin of the MCA Window using the mouse.

5.1.2.2 Click on the Adjust option box located in the left margin of the MCA Window.

5.1.2.3 Click on the HVPS option box. Confirm that the initial settings are as follows:

Voltage:	3500 V.
Status:	On
Over/Inh. State:	Clear
Over Latch:	Disable
Inh. Latch:	Disable
Inh. Signal:	5 V.

5.1.3 Verify or establish the amplifier gain settings.

5.1.3.1 Click on the MCA option box located in the left margin of the MCA Window.

5.1.3.2 Click on the Adjust option box located in the left margin of the MCA Window.

5.1.3.3 Click on the AMPLIFIER option box. Confirm that the initial settings are as follows:

Coarse Gain:	X2.5
Fine Gain:	(adjustable)
S-Fine Gain:	1.0000X
BLR Mode:	Sym
PUR:	On
Preamp Type:	RC
Shaping Mode:	Gaussian
Shaping Time:	4 μSec
Input Mode:	Normal
Input Polarity:	Negative
LTC Mode:	Normal
Inh. Polarity:	Positive

5.1.3.4 **The fine gain adjustment is described in the following section.**

5.1.3.5 **Log the amplifier gain settings in the HPGe logbook.**

5.1.4 **Verify or establish the initial ADC Settings**

5.1.4.1 **Click on the MCA option box located in the left margin of the MCA Window using the mouse.**

5.1.4.2 **Click on the Adjust option box located in the left margin of the MCA Window.**

5.1.4.3 Click on the ADC option box. Confirm that the initial settings are as follows:

Conv. Gain:	8192
Offset:	0
LLD:	2.00%
ULD:	110%
Zero:	± 0.500%
Acq. Mode:	PHA
Anticoinc.:	Coinc
Late Coinc.:	Early
Peak Detect:	Auto
Xfer Timing:	Overlap
LTC/PUR:	LG

5.1.5 Establish or verify the amplifier gain and ADC zero settings.

5.1.5.1 Place a mixed gamma calibration standard that includes at least two well-spaced photon energies spanning the energy calibration range of interest. A mixed gamma standard containing a low energy nuclide such as Cd-109 (88.03 keV) and a high energy nuclide such as Y-88 (1836.01 keV) should suffice.

5.1.5.2 Click on the Acquire On option box in the left margin of the MCA window to initiate spectral data acquisition.

5.1.5.3 Note the peak centroid channel locations for the 88-keV and 1836-keV lines. The recommended peak channel locations for a nominal *0.5* keV/channel system gain are as follows:

Nuclide	Energy(keV)	Peak Channel
Cd-109	88.03	176 ±2
Y-88	1836.01	3672 ±2
Difference	1747.98	3496 ±2

***5.1.5.4* Calculate the peak channel difference for the 88-keV and 1836-keV photon lines and compare to the preceding table.**

5.1.5.4.1 If the observed channel difference is too small, increase the amplifier gain setting by clicking on the Fine Gain option box with the mouse and adjusting.

5.1.5.4.2 If the observed channel difference is too large, decrease the amplifier gain setting by clicking on the Fine Gain option box with the mouse and adjusting.

5.1.5.5 Erase and acquire a new gamma spectrum by clicking on the Clear option box and repeat above steps until the desired channel difference is achieved.

5.1.5.6 Record any changes to the amplifier settings in the HPGe counting log and proceed to ADC Setup.

5.1.6 Analog-to-Digital Converter (ADC) Setup

5.1.6.1 Note the peak centroid channel location of the 1836-keV gamma line and compare to preceding table.

5.1.6.1.1 If the observed peak centroid channel location is less than the desired channel location, increase the ADC zero setting.

5.1.6.1.2 If the peak centroid channel location is greater than the desired channel location, decrease the ADC zero setting.

5.1.6.1.3 Erase and acquire a new gamma spectrum and repeat above steps until the desired peak channel location is achieved.

5.1.6.2 Record any changes to the ADC zero settings in the counting room log.

5.2 Calibrations

5.2.1 Initial Energy/Shape Calibration

5.2.1.1 **This is the initial energy and peak shape calibration. This type of calibration is only performed when initially setting up the HPGe detector system for the first time. Performing additional calibration geometries is described in the next section.**

Efficiency vs. energy curves are established (or re-established) each time the HPGe detector is calibrated see 5.2.2).

5.2.1.2 Select option #1 Gamma Counting from the Sample Counting Main Menu.

5.2.1.3 Select option #6 Calibrate a Detector from the Gamma Count Main Menu.

5.2.1.4 Select option #1 Energy/Shape Initial Calibration from the Detector Calibration Main Menu.

5.2.1.5 Select the desired detector at the Nbr Detector Name prompt from the Detector Main Menu.

5.2.1.6 Enter the analysis live time in seconds at the Preset Live Time prompt. The default time format is in seconds. Spectrum acquisition times should be sufficient to obtain well resolved photopeaks with at least 10,000 net counts in each of the photopeak areas.

5.2.1.7 Enter a "Yes" at the Wait for Acquisition prompt.

5.2.1.8 Place a NIST traceable source on the detector in the geometry of interest. A mixed gamma reference source with non-interfering calibration energies spanning the nominal energy range of 80 to 2000 kev should be used.

5.2.1.9 Enter a Return function key to continue with the Calibration.

5.2.1.10 Enter a Y (Yes) at the "Would you like to use the spectrum presently in the detector prompt".

5.2.1.11 Enter a N (No) at the Do you want to turn acquisition off to calibrate prompt.

5.2.1.12 Enter the Select function key at the option #1 Energy Calibration and option #2 FWHM Calibration prompt to select both energy and FWHM calibration options. The options will be underlined indicating both are selected.

5.2.1.13 Select the appropriate calibration certificate number option at the Certificate Menu prompt.

5.2.1.14 Move the mouse and cursor to the low energy photon peak and select option #1 low energy peak to highlight.

5.2.1.15 Move the mouse and cursor to the high energy photon peak and select option #2 high energy peak to highlight.

5.2.1.16 Enter the PF1 function key to accept low and high energy peak marker information.

5.2.1.17 Select the Perform/Update Calibration option at the Calibration Main Menu.

5.2.1.18 Select the Review option at the Calibration Review Main Menu. Energy calibration results should be within ± 2 percent of the known energies. The fitted shape or FWHM calibration results should be within ± 15 percent of the experimentally observed FWHM shapes.

5.2.1.19 Enter the PF3 Exit function key to update calibration information.

5.2.2 Energy/Shape/Efficiency Calibration

5.2.2.1 Select option #1 Gamma Counting from the Sample Counting Main Menu.

5.2.2.2 Select option #6 Calibrate a Detector from the Gamma Count Main Menu.

5.2.2.3 Select option #2 Energy/Shape/Efficiency Update Calibration from the Detector Calibration Main Menu.

5.2.2.4 Select the desired detector at the Nbr Detector Name prompt from the Detector Main Menu.

5.2.2.5 Enter the analysis live time in seconds at the Preset Live Time prompt. The default time format is in seconds. Spectrum acquisition times should be sufficient to obtain well resolved photopeaks with at least 10,000 net counts in each of the photopeak areas.

5.2.2.6 Enter a "Yes" at the Wait for Acquisition prompt.

5.2.2.7 Place a NIST traceable source on the detector in the geometry of interest. A mixed gamma reference source with non-interfering calibration energies spanning the nominal energy range of 80 to 2000 keV should be used.

5.2.2.8 Enter a Return function key to continue with the Calibration.

5.2.2.9 Enter a Y (Yes) at the "Would you like to use the spectrum presently in the detector" prompt.

5.2.2.10 Enter a N (No) at the Do you want to turn acquisition off to calibrate prompt.

5.2.2.11 Enter the PF1 Select function key at the option #1 Energy Calibration option #2 FWHM Calibration and option #3 Efficiency prompt to select all three calibration options. The options will be underlined indicating selection.

5.2.2.12 Select the appropriate calibration certificate number option at the Certificate Menu prompt.

5.2.2.13 Move the mouse and cursor to the low energy photon peak and select option #1 low energy peak to highlight.

5.2.2.14 Move the mouse and cursor to the high energy photon peak and select option #2 high energy peak to highlight.

5.2.2.15 Enter the Select function key to accept low and high energy peak marker information.

5.2.2.16 Select the Perform/Update Calibration option at the Calibration Main Menu.

5.2.2.17 Select option #1 Energy, #2 FWHM, #3 Efficiency at the Calibration Review Main Menu.

5.2.2.18 Enter the PF3 Exit function key to update calibration information.

5.2.2.19 Enter a Y (Yes) at the Would you like to generate calibration report prompt.

5.2.2.20 Review the Calibration Report and ensure that the residuals from the fitted values as compared to the experimentally observed values are within the following acceptance criteria:

FWHM:	± 15 %
Efficiency:	± 10 %

5.2.2.21 Verify the efficiency calibration by analyzing a known standard of the same geometry as a sample as described in the following section.

5.3 Routine Operations

5.3.1 Daily Checks

5.3.1.1 The Efficiency checks are performed as follows:

5.3.1.1.1 Place the check source in the proper counting geometry on the HPGe detector.

Note: A record of the check is maintained in the computer.

5.3.1.1.2 Select option #1 Gamma Counting from the Sampling Counting Main Menu.

5.3.1.1.3 Select option #5 Quality Control from the Gamma Counting Main Menu.

5.3.1.1.4 Select option #1 Calibration Check from the Quality Control Menu.

5.3.1.1.5 **Select the desired detector at the Nbr Detector Name prompt from the Detectors menu.**

5.3.1.1.6 **Select the proper geometry option.**

5.3.1.1.7 **Select the appropriate quality control certificate option at the Nbr Certificate Name prompt from the Certificate Files Menu.**

5.3.1.1.8 **Place the check source for the geometry and QA file sleeted in step G on the detector and Enter a Return to begin acquisition. Data acquisition will automatically begin for the preset time established in the quality control check file.**

5.3.1.1.9 Review the Calibration Check report and confirm the low and high energy points have passed the bounds test for the following information:

Peak Centroid
Peak FWHM
Peak Efficiency (Decay Corrected Activity)

5.3.1.1.10 If any of the parameters fail, repair the obvious (such as a faulty energy calibration) and repeat check.

5.3.1.1.11 Deleted

5.3.1.2 Background Checks are performed as follows:

5.3.1.2.1 Open the shell door and check to ensure counting cave is empty. Close shell door prior to proceeding.

Note: A record of the check is maintained in the computer.

5.3.1.2.2 Select option #1 Gamma Counting from the Sampling Counting Main Menu.

5.3.1.2.3 Select option #5 Quality Control from the Gamma Counting Main Menu.

5.3.1.2.4 Select option #2 Background Check from the Quality Control Menu.

5.3.1.2.5 Select the desired detector at the Nbr Detector Name prompt from the Detectors menu.

5.3.1.2.6 Verify step 5.3.2.a. prior to proceeding and Enter a Return to start acquisition. Data acquisition will automatically begin for the preset time established in the background control check file.

5.3.1.2.7 Review the Background Check report for the presence of significant peaks indicating contamination. Decontaminate detector or detector chamber as necessary.

5.3.1.3 ***Deleted***

5.3.2 Routine Sample Analysis

5.3.2.1 Place the sample in the proper counting geometry on the HPGe detector.

5.3.2.2 Record sample identification information in the Germanium Sample Log.

5.3.2.3 Select option #1 Count a Sample from the Gamma Counting Main Menu.

5.3.2.4 Select option #1 the desired detector at the Nbr Detector Name prompt from the Detectors Menu.

5.3.2.5 Select option desired analysis sequence from the Nbr Analysis Name prompt.

5.3.2.6 Select the appropriate sample geometry at the Nbr Geometry prompt from the Geometry Files menu.

5.3.2.7 Place sample on detector in appropriate geometry configuration. Enter a RETURN to continue. The system will respond with the Acquisition has started message.

5.3.2.8 Enter the Preset Live Time in seconds at the prompt, if needed. They are normally pre set already.

5.3.2.9 Enter the Sample ID at the prompt.

5.3.2.10 Enter the Sample Quantity or mass in grams.

5.3.2.11 Enter the desired Sample Units (i.e., grams) at the prompt. Normally, units are pre-set.

5.3.2.12 Enter the Sample Date/Filter End Date and Time at the prompt.

5.3.2.13 Record Sample Number End from prompt as File # in the Germanium Sample Log.

5.3.2.14 Review or edit inputs as necessary and select the PF1 function key to process/accept information.

5.3.2.15 The system message Submitting the procedure which waits for acquisition to finish will be displayed on the monitor. The

analysis report will be printed at the completion of counting (see example Attachment #1).

5.2.3.16 At the completion of counting, analysis results will be stored to a results file on the MicroVax computer.

5.2.3.17 Select the PF3 function to return the counter to the Sample Counting Main Menu.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Submit all ***results to*** the ***H***ealth ***P***hysics ***S***upervisor.

7.0 ATTACHMENTS

7.1 Attachment #1 HJPGe detector minimum detectable activities (MDA) as calculated per US-NRC regulatory Guideline 4.14. (Example)

7.2 Attachment #2 ***Deleted***

Kerr-McGee Gamma Report Generated 15-JUN-1995 08:50:22

Configuration : DKA200:[GAMMA.SCUSR.ARCHIVE]BKG_MARINELLI_GE1_MARINELLI_6831.CNF;1

---- Sample Information ----

Sample Title	:		
Sample ID	: Marinelli	Sample Quantity	: 1.00000E+00 EA
Sample Type	:	Sample Geometry	:
Sample Number	: 6831	Spctrm Collector	: RAY LANCASTER
Analyzed By	:		

---- Sample Deposition Information ----

Dep. Correction?	: No	Dep. Duration	:
Deposition Start	:	Deposition End	: 17-FEB-1995 00:00:00

---- Sample Decay/Count Information ----

Sample Date	: 17-FEB-1995 00:00:00	Acquisition date	: 17-FEB-1995 15:07:19
Decay time	: 0 15:07:19.21	% dead time	: 0.1%
Elapsed live time	: 0 00:16:40.00	Elapsed real time	: 0 00:16:40.95

---- Detector Parameters ----

Energy cal. time	: 13-FEB-1995 12:10:32	Energy cal. oper.	: RAY LANCASTER
Detector name	: GE1	Counting geometry	: Marinelli
Effic. cal. time	: 13-FEB-1995 14:34:23	Effic. cal. oper.	: RAY LANCASTER

---- Processing Parameters ----

Start channel	: 50	End channel	: 8192
Sensitivity	: 5.00000	Gaussian Sens.	: 10.00000
Critical level?	: No	Propagate Errors?	: Yes
Empirical Eff?	: Yes	Library-based eff	: Yes
Energy tolerance	: 2.00000	Half life ratio	: 30.00000
Abundance limit	: 75.00000	WTM error limit	: 3.00000
MDA Width (FWHM)	: 3.00000	MDA Confid Level	: 5.00000 %

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	511.35	29	0	1.52	1022.83	1018	12	2.90E-02	18.6	

Interference Report Page : 2
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

No interference correction performed

Summary of Nuclide Activity Page : 3
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Total number of lines in spectrum	1	
Number of unidentified lines	0	
Number of lines tentatively identified by NID	1	100.00%

**** There are no nuclides meeting summary criteria ****

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Nuclide Line Activity Report Page : 4
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Flag: "*" = Keyline

Unidentified Energy Lines Page : 5
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	%Eff	Flags
0	511.35	29	0	1.52	1022.83	1018	12	2.90E-02	37.1	1.32E+00	T

Flags: "T" = Tentatively associated

Rejected Report Page : 6
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Nuclide	Half-life	Half-Life Ratio	Energy	%Abund	2-Sigma Activity	%Error	Rejected by
TL-208	1.41E+10Y	0.00	74.96	3.34	--- Not Found ---		Abun.
			84.90	1.52	--- Not Found ---		
			510.84	21.60	2.738E-04	45.73	
			583.14*	84.20	--- Not Found ---		
			860.37	12.46	--- Not Found ---		
			2614.66	99.80	--- Not Found ---		
		% Abundances Found =		9.69	(Abn. Limit = 75.00%)		

Flag: "*" = Keyline

Minimum Detectable Activity Report Page : 7
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/EA)
K-40	6.	1460.81	3.8628E+02
TL-208	4.	583.14	1.8799E+01
PB-210	9.	46.50	4.2948E+02
BI-212	6.	727.17	3.0388E+02
PB-212	11.	238.63	2.6746E+01
BI-214	5.	609.31	3.7202E+01
PB-214	5.	351.92	3.0523E+01
RA-226	19.	186.21	3.9854E+02
AC-228	2.	911.07	5.6099E+01
TH-230	6.	67.67	1.9249E+03
PA-234M	8.	92.59	1.2858E+02
TH-234	8.	92.59	1.2858E+02
U-235	16.	185.71	2.2349E+01

Combined Activity-MDA Report
Sample ID : Marinelli

Page : 8
Acquisition date : 17-FEB-1995 15:07:19

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/EA)	K.L. Ided	Act error	MDA (pCi/EA)	MDA error	Act/MDA
K-40	1.203E+02		3.339E+02	3.863E+02	6.085E+01	0.311
TL-208	-1.642E+01		2.618E+01	1.880E+01	4.185E+00	-0.873
PB-210	1.809E+02		3.565E+02	4.295E+02	1.598E+02	0.421
BI-212	1.775E+02		2.192E+02	3.039E+02	4.737E+01	0.584
PB-212	6.179E+00		2.457E+01	2.675E+01	5.070E+00	0.231
BI-214	-1.132E+01		4.289E+01	3.720E+01	7.478E+00	-0.304
PB-214	-8.746E+00		3.272E+01	3.052E+01	5.483E+00	-0.287
RA-226	8.464E+01		3.678E+02	3.985E+02	7.249E+01	0.212
AC-228	-1.709E+01		6.757E+01	5.610E+01	9.084E+00	-0.305
TH-230	-8.953E+02		2.240E+03	1.925E+03	3.535E+02	-0.465
PA-234M	-1.519E+03		5.105E+03	1.286E+02	1.951E+01	-11.811
TH-234	-1.153E+01		1.221E+02	1.286E+02	1.951E+01	-0.090
U-235	-4.287E+01		9.668E+01	2.235E+01	4.126E+00	-1.918

MOISTURE ANALYSIS

1.0 SCOPE

1.1 Purpose

This procedure shall be used to determine the moisture content in soils at the West Chicago Project.

1.2 Applicability

This procedure applies to all analyses of moisture in soils at the West Chicago Project.

2.0 REFERENCES

2.1 MAX Moisture Analyzer User Manual.

3.0 DEFINITIONS

3.1 None

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 The MAX-50 Moisture Analyzer is operational and warmed up for at least 20 minutes.

4.2.2 The MAX-50 shall be calibrated prior to use.

4.2 Tools and Equipment

4.2.1 Calibration weights, a 10 gram and a 6 gram

4.2.2 Weighing pans, AZI stock number 990-0008-00 or equivalent

4.2.3 MAX-50 Moisture Analyzer

4.2.4 Scale, if not using the MAX-50 Moisture Analyzer

4.2.5 Oven, if not using the MAX-50 Moisture Analyzer

4.3 Precautions, Limits

4.3.1 The MAX-50 Moisture Analyzer uses a heating element in the lid that, while in use, can cause serious burns if in contact with unprotected skin.

4.3.2 The MAX-50 Moisture Analyzer has a max weight capacity of 20 grams.

4.3.3 The balance in the MAX-50 Moisture Analyzer is a precision balance. Care should be used when placing or removing items so that the balance is not damaged.

4.3.4 Gloves shall be worn when handling the calibration weights.

4.3.5 Exercise care when transferring samples in to or out of the oven.

4.4 Acceptance Criteria

4.4.1 The acceptable range for the calibration test on the MAX-50 Moisture Analyzer is between 37.48 - 37.54 %.

5.0 PROCEDURE

5.1 Calibration of the MAX-50 Moisture Analyzer

5.1.1 Verify the analyzer is on and warmed up for at least 20 minutes.

5.1.2 Open the lid and place an aluminum pan onto the sample tray support.

5.1.3 Close the lid and press the start button.

5.1.4 When the "LOAD" light illuminates, press the "% SAMPLE" button.

5.1.5 Open the lid and place the 10 gram and the 6 gram weight on the sample pan.

5.1.6 Close the lid and observe the display. If the balance is operating the display should read 75-85%.

5.1.7 If the display does not read between specified range, press the reset button, remove the calibration weights, and place the analyzer out of service.

5.1.8 Close the lid to start the analysis cycle.

> **NOTE**
> The heat lamp will energize as part of the analysis cycle. Care should be used when opening the lid and handling the weights.

5.1.9 When the heat lamp illuminates, open the lid and remove the 6 gram weight.

> **NOTE**
> Care must be used when removing the weight. If the sample pan is disturbed, the red "SYSTEM FAILURE" light will illuminate and the display will read "1".

5.1.10 If a system failure occurs, press the reset button, remove the calibration weights, and restart the test at step 5.1.5.

5.1.11 Close the lid and wait for the analysis cycle to complete.

5.1.12 When the green "FINAL" light illuminates, indicating the completion of the analysis, the display will indicate the % moisture. If the display does not read 37.48 to 37.54%, place the analyzer out of service.

5.1.13 If the display is within the acceptable range, initial the Lab Daily Routine Sheet for the calibration.

5.1.14 Open the lid and remove the calibration weights, return them to their storage location, and close the lid of the analyzer.

5.2 Moisture Determination Using the MAX 50 Moisture Analyzer

5.2.1 Verify the analyzer is energized and has warmed up for at least 20 minutes.

5.2.2 Verify analyzer calibration by observing the sign off on the Lab Daily Routine Sheet.

5.2.3 Open the lid and remove any sample pans.

5.2.4 Place a sample pan on the sample pan support.

5.2.5 Close the lid and press the "START" or the "HISTART" button.

> **NOTE**
> Maximum sample weight of 20g may be analyzed. The display will

read out the percent of sample. When ***sufficient*** sample has been placed on the sample pan the analyzer will beep and the amber "CLOSE" light will illuminate.

5.2.6 When the load light illuminates, open the lid and place the sample in the sample pan.

5.2.7 When the "CLOSE" light illuminates, close the lid to start the analysis cycle.

5.2.8 When the green "FINAL" light illuminates, the analysis cycle is complete. The display will read the % Moisture.

5.2.9 Record the % Moisture on the Moisture Analysis Log, Attachment 1.

5.2.10 Open the lid, remove the sample pan, and close the lid.

5.2.11 Repeat steps 5.2.4 to 5.2.10 for each sample to be analyzed.

5.3 Moisture Determination using a Scale

5.3.1 Verify the scale to be used has been calibrated for the day by observing the sign off on the Lab Daily Routine Sheet.

5.3.2 Weigh the sample and determine the net weight of the sample.

5.3.3 Dry the sample for at least 24 hours at a minimum of 100 degrees C.

5.3.4 Reweigh the sample and determine the net weight.

5.3.5 Subtract the net weight measured in 5.3.4 from the net weight measured in step 5.3.2.

5.3.6 Divide the value obtained in step 5.3.5 by the weight obtained in 5.3.2 and multiply the value by 100.

5.3.7 Record the value from 5.3.6 as the % Moisture on the Moisture Analysis Log.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Records

6.1.1 Lab Daily Routine Sheet

6.1.2 Moisture Analysis Log

6.2 Retention

Records generated in the performance of this procedure will be retained for the duration of the West Chicago Project.

6.3 Reports

Report analysis results as required for that sample type.

6.3 Notifications

Notify lab supervision of conditions requiring analyzer to be place out of service.

7.0 ATTACHMENTS

7.1 ***Attachment 1*** Typical Moisture Analysis Log

MOISTURE ANALYSIS LOG

DATE	TIME	MAX-50 USED (Y/N)	SCALE SERIAL #	AS RECEIVED NET WEIGHT	DRY NET WEIGHT	% MOISTURE	TECH INITIALS

APPROVED BY _____ DATE: _____

PORTABLE SURVEY INSTRUMENT OPERABILITY CHECKS

1.0 SCOPE

1.1 Purpose

To provide a means to document the operability of portable survey instruments.

1.2 Applicability

This procedure is required of all project personnel performing radiological surveys using portable instruments.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 ANSI N323-1978

3.0 DEFINITIONS

Source Check

A test of an instrument's response to a known radiation field in order to verify operability of the instrument.

4.0 REQUIREMENTS

4.1 Prerequisites

None.

4.2 Tools, Material, Equipment

4.2.1 Calibrated survey meters.

4.2.2 Necessary radioactive sources to verify operability of each type of instrument.

4.3 Precautions, Limits

Do not subject portable survey meters to physical abuse or water.

4.4 Acceptance Criteria

4.4.1 The survey instruments indicate a satisfactory response to the battery check prior to ***each day of use.***

4.4.2 The survey instruments indicate a satisfactory response to the check source (mean ± 20%) prior ***to each day of use.***

5.0 PROCEDURE

5.1 Portable survey instruments will be source ***checked, after*** repair and calibration, or prior to ***each day of use.***

5.2 Alpha Instruments:

5.2.1 Select the desired instruments.

5.2.2 Record the current date and time on Attachment 1.

5.2.3 Check the calibration due date on each instrument to ensure that the calibration has not expired. ***If calibration has expired, go to paragraph 5.4 below.***

5.2.4 Check instrument for satisfactory physical condition. If excessive dents, torn Mylar or loose parts are found, place the instrument out of service.

5.2.5 Perform a battery check and record the results on Attachment 1.

5.2.5.1 Replace the batteries if they are low.

5.2.5.2 ***If the batteries are dead, take the instrument "out of service".***

5.2.6 Perform a source check and record the results in the appropriate columns on Attachment 1.

> NOTE
> The instrument must indicate within ± 20% of the expected response ***(source activity)*** listed on Attachment 1.

> NOTE
> The 43-20 alpha gas probes are interchangeable with the LM-12 count ratemeters. Periodic field checks of the instrument using the source attached to the instrument are required to verify continuing operability. Should the field check indicate no response or a reduced response, return the instrument to determine if the probe requires replacement or the if instrument requires repair.

5.2.7 Source check each quadrant of the Ludlum Model 43-20 alpha probe and record the results in the appropriate column.

5.2.8 Average the four quadrant reading and record this value on Attachment 1.

5.2.9 Record your initials next to each instrument checked on Attachment 1.

5.2.10 If an instrument is ***found to be inoperable,*** note on Attachment 1 why it is ***being placed out of*** service (i.e. out of calibration, ***damage*** repair, etc.) ***and go to 5.4 below.***

5.3 ***Beta*** Gamma Instruments:

5.3.1 Select the desired instruments.
5.3.2 Record the current date and time on Attachment 1.

5.3.3 Check the calibration due date on each instrument to ensure that the calibration has not expired. ***If calibration has expired, go to paragraph 5.4 below.***

5.3.4 Check instrument for satisfactory physical condition. If excessive dents, broken windows, or loose parts are found, place the instrument out of service.

5.3.5 Perform a battery check, and record the results on Attachment 1.

5.3.5.1 *Replace the batteries if they are low.*

5.3.5.2 *If the batteries are dead, take the instrument "out of service".*

5.3.6 Perform a ***source*** check with a Cs-137 source and record the results on Attachment 1.

> NOTE
> Reference readings shall be obtained on each instrument when exposed to a check source in a constant and reproducible manner at the time of, or promptly after, ***instrument*** calibration.

5.3.7 Record your initials next to each instrument checked on Attachment 1.

5.3.8 If an instrument is found to be inoperable, note on Attachment 1 why it is being placed out of service (i.e. out of calibration, damage repair, etc.) and go to 5.4 below.

5.4 INSTRUMENT OUT OF CALIBRATION

5.4.1 When a instrument is found to be "out of calibration" or fails ***an operability*** check, immediately notify the HP Supervisor.

5.4.2 Source check failures ("out of calibration") are to be recorded in the instrument log book and a nonconformance report (NCR) shall be initiated per QPM-DOC #9, in order to ***document the necessary corrective action(s) and to allow for management to*** assess trends. ***NCR's are not initiated for***

instruments found with expired calibration due dates, and have not been used.

5.4.*3* The HP Supervisor shall determine the last date that the ***used*** instrument passed a ***source check,*** or the last calibration date, whichever is ***most recent.***

5.4.*4* Based on the last acceptable ***source check or calibration*** date, the HP Supervisor shall ***identify which*** radiological surveys were performed ***since then*** with the defective instrument.

5.4.*5* The HP Supervisor shall determine whether regulatory or general information surveys were performed with the defective instrument.

5.4.*6* Using previous surveys or previous knowledge of the survey data, the HP Supervisor shall determine whether the surveys taken with the defective ***instrument*** are acceptable ***"as is"*** or ***whether*** the surveys must be reperformed. In the case of regulatory surveys, ***they*** shall be retaken, if possible. ***If*** resurveying is not possible, the HP Supervisor will make a written assessment ***as to*** the quality of the data. ***This assessment may also be used to disposition the NCR.***

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Notifications required by the procedure will typically be verbal to the H. P. Suvervisor.

6.*2* Forward the completed Attachment 1 forms to Health Physics Supervision for review.

6.*3* Any instruments that have ***dead batteries or*** failed ***the*** source checks have been removed from service ***and so noted on Attchment 1 and instrument log book.***

6.4 Forward the dispositioned NCR to the Site manager for review and project filing.

7.0 ATTACHMENTS

7.1 Attachment 1 Portable Instrument Accountability Form (Example)

ATTACHMENT 1

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

DATE	TIME	A.M.
		P.M.

ALPHA SURVEY INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	SOURCE ACTIVITY	INSTRUMENT RESPONSE	SOURCE ACTIVITY	INSTRUMENT RESPONSE	BATTERY CHECK	REMARKS	INITIALS
PAC-4G w/AC-21 PROBE 1505							
3986							
3992							
4015							
4022							
4044							
4058							
4177							
4178							
6057-02							
6057-03							
6057-04							
6057-05							

ATTACHMENT 1

DATE | TIME A.M. P.M.

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

ALPHA SURVEY INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	SOURCE ACTIVITY	INSTRUMENT RESPONSE	SOURCE ACTIVITY	INSTRUMENT RESPONSE	BATTERY CHECK	REMARKS	INITIALS
PRM-6 w/AC-3 PROBE 647							
653							
736							
765							
779							
1259							
Ludlum 43-20 Alpha Detector w/LM-12 Instrument		**Average Response**		**Average Response**		**Indicate quadrant and response**	
Inst. Number						1 2 3 4	

DATE	TIME A.M. / P.M.

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

ALPHA SURVEY INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	SOURCE ACTIVITY	INSTRUMENT RESPONSE	SOURCE ACTIVITY	INSTRUMENT RESPONSE	BATTERY CHECK	REMARKS	INITIALS
Ludlum 43-20 Alpha Detector w/LM-12 Instrument		Average Response		Average Response		Indicate quadrant and response	
Inst. Number						1 2 3 4	

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

DATE	TIME	A.M. / P.M.

BETA-GAMMA INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	PROBE USED	BATTERY CHECK	HIGH VOLTAGE CHECK	RESPONSE CHECK	REMARKS	INITIALS
PRM-6 648	HP-210					
1263	HP-210					
1270	HP-210					
E-530 410	HP-270					
1133	HP-270					
1180	HP-270					
PRM-7 364	NaI					
699	NaI					
704	NaI					
707	NaI					
H.P.I. 1010 345	IC					

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

DATE	TIME	A.M. / P.M.

BETA-GAMMA INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	PROBE USED	BATTERY CHECK	HIGH VOLTAGE CHECK	RESPONSE CHECK	REMARKS	INITIALS
LUDLUM MODEL 3 113990	44-40					
115345	44-40					
115385	44-40					
115025	44-40					
LUDLUM MODEL 3 114947	44-38					
115046	44-38					
115065	44-38					
115117	44-38					
115375	44-38					

CALIBRATION OF THE LUDLUM SCALER RATEMETER MODEL 2221

1.0 SCOPE

1.1 Purpose

To provide a standard procedure for the calibration of the Ludlum Ratemeter, model 2221 with the 44-10, 44-62 sodium iodide scintillation probes.

The 2221 is a portable, battery operated, self contained counting instrument designed for operation with scintillation, proportional or G-M detectors. When combined with scintillation detectors, the 2221 is used for the detection and measurement of gamma radiation. This instrument is used for down hole gamma logging as well as the detection of surface radioactivity.

1.2 Applicability

This instrument will be calibrated every twelve months, after repairs, or when the instrument readings are questionable. This procedure can be used with any ratemeter/sodium iodide scintillation detector combination. Typically the 44-62 half-inch detector is not used for surface scanning.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan Kerr-McGee Chemical Corporation

2.4 Technical Manual for Scaler Ratemeter, Model 2221

2.5 Kerr-McGee calibration standard blocks manufactured by K-M Technology and Engineering Report TR-94013

2.6 Calibration Drum Data 12 July 1995 and Calibration Drum Data from Sewage

3.0 DEFINITIONS

N/A

4.0 REQUIREMENTS

4.1 Prerequisites

None.

4.2 Tools, Material, Equipment

4.2.1 Small screwdriver.

4.2.2 Ludlum Model 500 pulser or equivalent.

4.2.3 Certified, NIST-traceable source of sufficient activity to allow a response check.

4.3 Precautions, Limit .

4.3.1 The connector cord is easily damaged if the weight of the 44-10 detector is suspended with it.

4.3.2 Do not leave the reading lamp on for any length of time as it will rapidly drain the battery voltage.

4.4 Acceptance Criteria

The instrument response to the certified calibration source should be within ± 20% in order to be acceptable.

5.0 PROCEDURE

5.1 Generic calibration applicable to all detectors.

NOTE: Calibrations for Surface activity and downhole logging are detailed in section 5.2.

5.1.1 Check the battery condition by pressing the "BAT" button with instrument switched on. If the meter does not indicate the battery charge above 5.3

volts, replace the four (4) D-cell batteries.

5.1.2 Set the threshold value as follows:

5.1.2.1 With the instrument turned on, press the threshold button. Read the displayed reading, if necessary adjust the "**THR**" adjustment screw until the threshold reads **100.**

NOTE: The 'THR" adjustment screw is located under the calibration cover.

5.1.3 Set the window value as follows:

5.1.3.1 With the instrument turned on press the "**WIN**" button and observe the reading, if the reading does not indicate approximately **3830** then with the "win button depressed adjust the reading to 3830.

NOTE: The '**WIN**" adjustment screw is located under the calibration cover

5.2 SPECIFIC USE CALIBRATION

5.2.1 Surface Soil concentration Calibration

5.2.1.1 Use attachment 1 for calibration if the instrument is to be used for surface surveying.

5.2.2 Downhole logging

5.2.2.1 If instrument is to be used for downhole logging then proceed to attachment 2 for the calibration procedure.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Instrument is properly calibrated and available for use or it has been placed out of service for repair.

6.2 Attachments have been reviewed and filed.

6.3 The equipment history has been updated.

7.0 ATTACHMENTS

7.1 Attachment 1 Soil Concentration Calibration Instructions

7.2	Attachment 2	Downhole Logging Calibration Instructions
7.3	Attachment 3	Soil Concentration Calibration Form
7.4	Attachment 4	Calibration Sticker
7.5	Attachment 5	Downhole logging Calibration Data Form

Attachment 1
CALIBRATION OF 2221 WITH 44-10 FOR SURFACE SCANNING

WORK INSTRUCTION

1. Record the instrument and detector serial numbers on attachment 3.
2. Perform a scaler linear check as follows:
   - 2.1 Record the pulser model/serial number on attachment 3
   - 2.2 Record the calibration due date on attachment 3
   - 2.3 Check the threshold setting to insure that it is set at 100mv, if it is not set at 100mv then adjust it in accordance with section 5. .
   - 2.4 Connect the pulser to the instrument.
   - 2.5 Send 400,4000.40K and 400K cpm pulses into the meter
   - 2.6 Record the meter responses in the "AS FOUND"column of attachment 3.
   - 2.7 If the meter does not indicate the correct response to within ± 10% perform the following steps as necessary:
     - 2.7.1 Send 400 cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.2 Send 4000 cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.3 Send 40k cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.4 Send 400k cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.5 Record the resulting readings in the after adjustment column on attachment 3
     - 2.7.6 If unable to adjust to within ± 10% , place the instrument out of service for repair.

1.3 PERFORM A VOLTAGE AND BACKGROUND AS FOLLOWS:

- 1.3.1 Record the source isotope and serial number on attachment 3.
- 1.3.2 Perform a source plateau by exposing the detector to a radioactive source and recording the meter reading at 50 volt increases until a plateau is developed. record the voltage and the meter reading for each increment on attachment 3.
- 1.3.3 At selected voltage increments perform a background reading and record the meter reading on attachment 3 .
  - 1.3.3.1 Set the meter high voltage to between 1/3 and 1/2 of the voltage plateau.
  - 1.3.3.2 Record the selected high voltage setting on attachment 3.

1.4 INSTRUMENT BACKGROUND

- 1.4.1 Perform an instrument ***background*** as follows:
  - 1.4.1.1 Using the four background blocks, perform six - one minute counts (with the instrument set at the selected voltage) and set in the scaler mode.
  - 1.4.1.2 Record these readings on attachment 3
  - 1.4.1.3 Average the six readings and record the result on attachment 3.

1.5 CALIBRATION SOURCE BLOCK DATA

- 1.5.1 Record the source block serial number on attachment 3
- 1.5.2 Perform six one minute source block counts
- 1.5.3 Record the results on attachment 3
- 1.5.4 Average the source block cpm and record the result on attachment 3
- 1.5.5 Subtract the average background (recorded on attachment 3) from the average source block cpm .
- 1.5.6 Record this number as the net average on attachment 3.

1.6 ACTIVITY CALCULATION

1.6.1 Perform the calculation on attachment 3 to determine the activity cutoff value for 7.2 pCi/g.

1.6.2 Sign attachment 3

1.7 CALIBRATION STICKER

1.7.1 Complete the information required on attachment 4 and attach it to the side of the instrument.

Attachment 2

CALIBRATION OF 2221 FOR GAMMA DOWNHOLE LOGGING

WORK INSTRUCTION

1. Record the instrument and detector serial numbers on attachment 3.
2. Perform a scaler linear check as follows:
   - 2.1 Record the pulser model/serial number on attachment 3
   - 2.2 Record the calibration due date on attachment 3
   - 2.3 Check the threshold setting to insure that it is set at 100mv, if it is not set at 100mv then adjust it in accordance with section 5. .
   - 2.4 Connect the pulser to the instrument.
   - 2.5 Send 400,4000.40K and 400K cpm pulses into the meter
   - 2.6 Record the meter responses in the "AS FOUND"column of attachment 4.
   - 2.7 If the meter does not indicate the correct response to within ± 10% perform the following steps as necessary:
     - 2.7.1 Send 400 cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.2 Send 4000 cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.3 Send 40k cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.4 Send 400k cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.5 Record the resulting readings in the after adjustment column on attachment 3
     - 2.7.6 If unable to adjust to within ± 10% , place the instrument out of service for repair.

1.3 PERFORM A VOLTAGE AND BACKGROUND AS FOLLOWS:

- 1.3.1 Record the source isotope and serial number on attachment 3.
- 1.3.2 Perform a source plateau by exposing the detector to a radioactive source and recording the meter reading at 50 volt increases until a plateau is developed. record the voltage and the meter reading for each increment on attachment 4.
- 1.3.3 At selected voltage increments perform a background reading and record the meter reading on attachment 3 .
  - 1.3.3.1 Set the meter high voltage to between 1/3 and 1/2 of the voltage plateau.
  - 1.3.3.2 Record the selected high voltage setting on attachment 3.

1.4 INSTRUMENT BACKGROUND

- 1.4.1 Perform an instrument ***background*** as follows:
  - 1.4.1.1 Using the four background blocks, perform six-one minute counts (with the instrument set at the selected voltage) and set in the scaler mode.
  - 1.4.1.2 Record these readings on attachment 3
  - 1.4.1.3 Average the six readings and record the result on attachment 3.

1.5 CALIBRATION SOURCE BLOCK DATA

- 1.5.1 Record the source block serial number on attachment 3
- 1.5.2 Perform six one minute source block counts
- 1.5.3 Record the results on attachment 3
- 1.5.4 Average the source block cpm and record the result on attachment 3
- 1.5.5 Subtract the average background (recorded on attachment 3) from the average source block cpm .

1.5.6 Record this number as the net average on attachment 3.

1.6 ACTIVITY CALCULATION

1.6.1 Perform the calculation on attachment 3 to determine the activity cutoff value for 7.2 pCi/g.

1.6.2 Sign attachment 3

1.7 CALIBRATION STICKER

1.7.1 Complete the information required on attachment 4 and attach it to the side of the instrument.

1.8 DRUM CALIBRATION PROCEDURE

1.8.1 If the instrument and detector is also going to be used as a downhole Gamma logger the following calibration must also be performed.

1.8.1 After the instrument and detector have been calibrated for surface scanning, perform the following.

1.8.1.1 Connect the detector and the instrument with a 15 foot connecting cable.

1.8.1.2 Record the standard picocuries per gram for each calibration drum and record them on attachment *5*

1.8.1.3 Calibration Geometry must be the same as the Field Geometry, i.e. obtain a sample of the geoprobe steel pipe and insert it into the PVC calibration drums and place the down hole probe inside the geoprobe pipe.

1.8.1.*4* Take three one minute readings in each of the calibration drums located at the REF, and record the reading in the appropriate column on attachment 5

1.8.1.*5*Average the each three one minutes and record the result on attachment 5

1.9 ACTIVITY CALCULATION FOR WELL LOGGING

1.9.1 Perform a linear regression for the average readings for both the calibration drums equipped with steel augers as well as the PVC piping

1.9.2 Record the result on attachment 5

1.9.3 Calculate the activity for 5 pCi/g and & 7.2 pCi/g and record the results on attachment 5

1.9.4 Sign Attachment 5 and forward it for approval

1.10 CALIBRATION STICKER

1.10.1 Complete the information required on attachment 4 and attach it to the side of the instrument.

Attachment 3

Ludlum Model 2221/44-10 Calibration

Model 2221 serial number: _____

Probe 44-10 serial number: _____

Date: _____

Scaler Linear Check

Pulser model/serial number: _____ / _____

Calibration Due Date: _____

Threshold set to 100 mv. _____ (tech. init.)

Pulser setting in cts.	Multiplyer	As Found Scaler reading in cts.	After Adjustment Scaler reading in cts.
_____	X1	_____	_____
_____	X10	_____	_____
_____	X100	_____	_____
_____	X1000	_____	_____

Voltage Plateau

Source isotope/serial number: _____ / _____

BKGD PLATEAU		SOURCE PLATEAU	
volts	counts	volts	counts
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

operating voltage selected: _____

Ludlum Model 2221/44-10 Calibration

Model 2221 serial number: _____

Probe 44-10 serial number: _____

Date: ☐ window verified at about 3830

Instrument BKGD

1 minute BKDG counts

_____ _____

_____ _____

_____ _____

Average: _____

Source Block Data

Source block ID: _____

1 minute Source Block counts

_____ _____

_____ _____

_____ _____

Average: _____ cpm Net Average: _____ cpm

Activity Calculation

Net Average source count rate of: _____ cpm divided by 10 =_____

Times 7.2 = _____ (A)

Square root of (A) = _____ times 2 = _____ (B)

A) plus the average BKGD = _____ CPM/7.2 pCi

The cutoff value is: _____ (CPM/7.2 pCi minus (B))

Calibration performed by: _____ DATE: _____

Calibration approved by: _____ DATE: _____

ATTACHMENT 4
CALIBRATION STICKER

SCALER #	______	PROBE #	______	Check **Applicable Line**	
CAL DATE	______	TECHNICIAN	______	Geoprobe Pipe	______
				PVC Drum	______
CAL DUE	______	VOLTAGE SETTING	______	Auger Drum	______
				Cable Length	______
7.2 pCi/g = ______ CPM		SOIL CONCENTRATION ______		DOWNHOLE LOGGING ______	

SCALER #	______	PROBE #	______	Check **Applicable Line**	
CAL DATE	______	TECHNICIAN	______	Geoprobe Pipe	______
				PVC Drum	______
CAL DUE	______	VOLTAGE SETTING	______	Auger Drum	______
				Cable Length	______
7.2 pCi/g = ______ CPM		SOIL CONCENTRATION ______		DOWNHOLE LOGGING ______	

SCALER #	______	PROBE #	______	Check **Applicable Line**	
CAL DATE	______	TECHNICIAN	______	Geoprobe Pipe	______
				PVC Drum	______
CAL DUE	______	VOLTAGE SETTING	______	Auger Drum	______
				Cable Length	______
.2 pCi/g = ______ CPM		SOIL CONCENTRATION ______		DOWNHOLE LOGGING ______	

CALER #	______	PROBE #	______	Check **Applicable Line**	
CAL DATE	______	TECHNICIAN	______	Geoprobe Pipe	______
				PVC Drum	______
AL DUE	______	VOLTAGE SETTING	______	Auger Drum	______
				Cable Length	______
7.2 pCi/g = ______ CPM		SOIL CONCENTRATION ______		DOWNHOLE LOGGING ______	

SCALER #	______	PROBE #	______	Check **Applicable Line**	
AL DATE	______	TECHNICIAN	______	Geoprobe Pipe	______
				PVC Drum	______
AL DUE	______	VOLTAGE SETTING	______	Auger Drum	______
				Cable Length	______
7.2 pCi/g = ______ CPM		SOIL CONCENTRATION ______		DOWNHOLE LOGGING ______	

SCALER #	______	PROBE #	______	Check **Applicable Line**	
AL DATE	______	TECHNICIAN	______	Geoprobe Pipe	______
				PVC Drum	______
CAL DUE	______	VOLTAGE SETTING	______	Auger Drum	______
				Cable Length	______
2 pCi/g = ______ CPM		SOIL CONCENTRATION ______		DOWNHOLE LOGGING ______	

ATTACHMENT 5
DETECTOR CALCULATION

DETECTOR TYPE _____ **SER #**_____

CALIBRATION DRUMS W/PVC PIPING: CABLE LENGTH _____ **DIAMETER OF PIPE** _____ **SCH. OF PIPE** ____ 40, ____ 80

DRUM NUMBER	pCi/g	1ST COUNT (cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
CD-1	1.7				
CD-8	12.9				
CD-7	23.4				

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g

A= R= 5.0 pCi/g =_____CPM

B= 7.2 pCi/g =_____CPM

CALIBRATION W/STEEL HOLLOW STEM AUGER PIPING: CABLE LENGTH _____ **DIAMETER OF PIPE** _____ **SCH. OF PIPE** ____ 40, ____ 80

DRUM NUMBER	pCi/g	1ST COUNT(cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
10	2.4				
12	5.8				
13	22.4				

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g

A= R= 5.0 pCi/g =_____CPM

B= 7.2 pCi/g =_____CPM

CALIBR. DRUMS W/PVC & GEOPROBE STEEL PIPING: CABLE LENGTH _____ **DIAMETER OF PIPE** _____ **SCH. OF PIPE** ____ 40, ____ 80

DRUM NUMBER	pCi/g	1ST COUNT(cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
CD-1	1.7				
CD-8	12.9				
CD-7	23.4				

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g

A= R= 5.0 pCi/g =_____CPM

B= 7.2 pCi/g =_____CPM